ENGINEERING CONSTRUCTION WEEKLY

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June 9, 1938

Tramway buckets bringing aggregates into the mixing plant at Conchas Dam

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VOL. 120 *JUNE 9, 1938* No. 23

THIS WEEK AND NEXT

INGENIOUS CONSTRUCTION is required to found Conchas Dam in New Mexico on a difficult rock formation. Particularly noteworthy are the methods being used to prevent shale abutments from sliding into the excavation. An article on the construction work in this issue is followed by a description of the unusually modern concrete manufacturing plant being used by the contractor.

The U. S. Bureau of Public Roads has cooperated with the civil engineer corps of the Navy in collecting data on horizontal soil pressures for construction of a drydock.

Sewage pollution of the Fox River in Wisconsin is cut down considerably by construction of intercepting sewers and a disposal plant at Green Bay.

Deficiencies in available water supply and distribution facilities call for an expenditure of $10,000,000 at Houston, according to a recent report by consulting engineers.

Many thousands of dollars have been lost through flooding of the Westinghouse plant at East Pittsburgh resulting from backwater running up Turtle Creek from the Monongahela River. In the future this flooding is to be prevented by flood gates across the creek.

Methods used in analyzing the highway statistics now being compiled in a nationwide survey are the subject of an article in this issue which supplements one published in last week's issue.

NEXT WEEK—Favorable results in checking pavement troubles through stabilization of road bases are reported by the Texas Highway Department. New facts on producing power from municipal refuse are given.

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THE COVER PICTURE is a view along the two-mile aggregate-handling tramway at Conchas Dam. The concrete plant is described on page 811.

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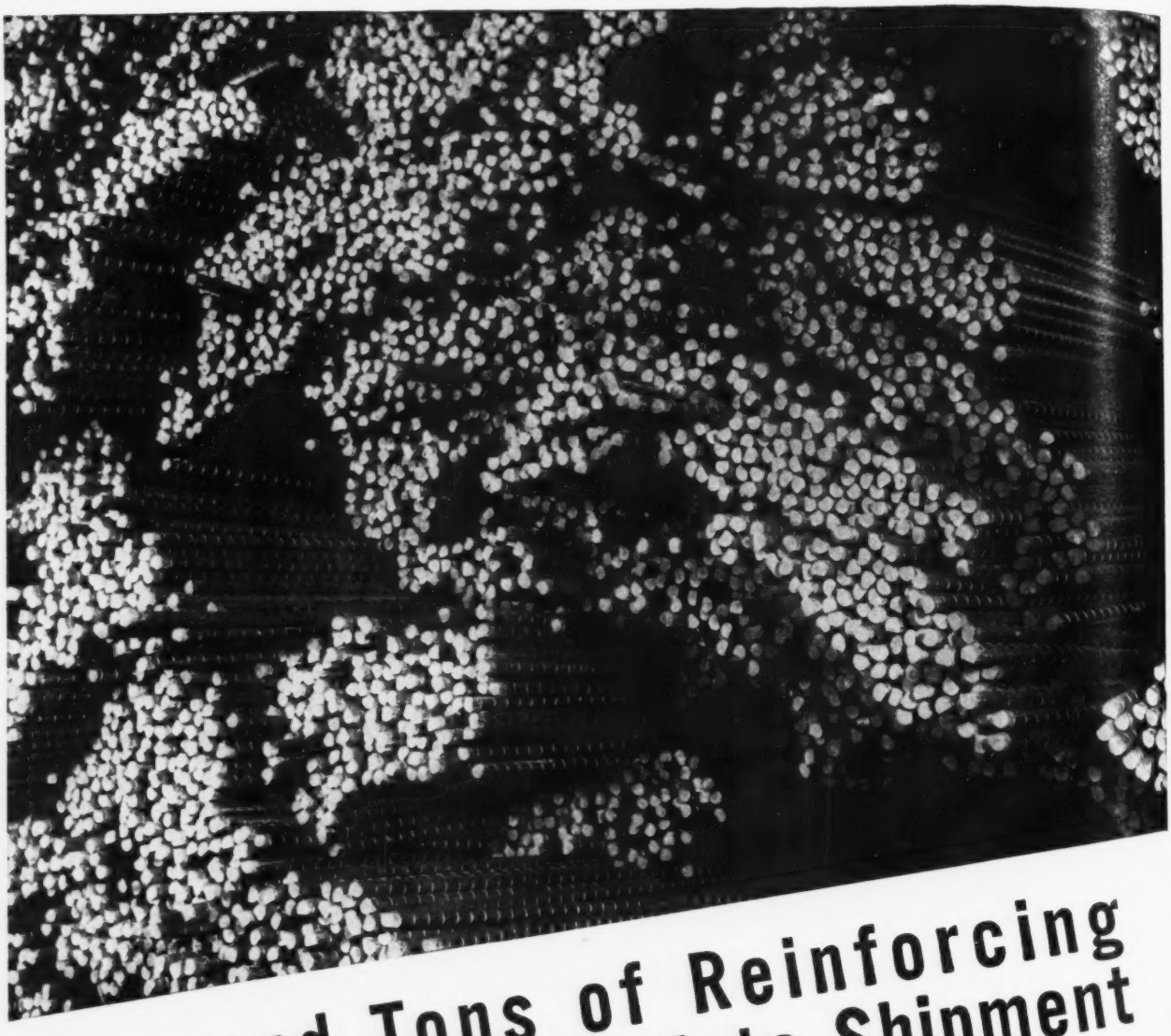

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JUNE 9, 1938

THE WEEK'S EVENTS

St. Lawrence Treaty Again Revived

U. S. Government asks Canada to join in new power and navigation treaty for border rivers

The United States Government, on May 31, sent to the Canadian Government the preliminary draft of a treaty proposing to set up a commission to plan for the development of the international sections of the Great Lakes-St. Lawrence system and to execute the plans when authorized by the respective governments. The commission, to be known as the Great Lakes-St. Lawrence Basin Commission, would consist of not more than ten members, equally divided between the two countries, and would be empowered to employ engineers, lawyers and others and to disburse funds which are made available to it.

Treaty scope widened

The proposed treaty is more comprehensive than any heretofore proposed. It includes not only development of the international section of the St. Lawrence River for power and navigation, which was covered by the rejected treaty of 1932, but also more complete development of the power resources of the Niagara River and construction of regulating works to control the levels of the Great Lakes. The treaty would limit the Chicago diversion to 1,500 sec.-ft. and would permit Canada to use for power development the water that it plans to bring into the Great Lakes system from the Hudson Bay drainage area. Work has begun on such a diversion project.

St. Lawrence development

Development of the International Rapids section of the St. Lawrence River is to be carried out along the lines laid down by the report of the Joint Board of Engineers dated July 13, 1927, with such modifications as may be agreed upon by the two governments, provided that such modifications do not increase the total cost as estimated in that report. These works would provide a navigation channel not less than 27 ft. deep together with suitable structures for the development of power. The commission is "to prepare a schedule allocating the construction of the recommended works to the governments on such basis that each government shall construct the work within its own territory or an equivalent proportion of the work in the

(*Continued on p. 796*)

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Two Shasta Dam Bids Received

Syndicates formed for construction of dam submit bids differing by only $263,000

Two bids for construction of Shasta Dam, varying in amount by only $263,000, were opened at Sacramento June 1 by the U. S. Bureau of Reclamation. Pacific Constructors, Inc., Los Angeles, a syndicate of twelve contracting firms, was the low bidder at $35,939,000. The other bid, $36,202,000, was submitted by the Shasta Construction Co., San Francisco, a syndicate of nine firms.

Stockholders of the Pacific Constructors, Inc., are Griffith Co., Los Angeles; Metropolitan Construction Co., Los Angeles; Lawler & Maguire of Butte, Montana; the Arundel Corp., Baltimore, Md.; American Concrete & Steel Pipe Co., Los Angeles; Foley Bros., New York City; D. W. Thurston,

(*Continued on p. 798*)

Bureau of Reclamation Photo

OPENING BIDS FOR SHASTA DAM

WALKER R. YOUNG, construction engineer of the Bureau of Reclamation in charge of the Central Valley project, reading the two bids received on June 1 for Shasta Dam, key structure in the Central Valley project of California. Low bid was submitted by Pacific Constructors, Inc., of Los Angeles, a syndicate of twelve contracting firms, at $35,939,000. The second bid was submitted by the Shasta Construction Co. of San Francisco.

Federal Road Bill Passes Congress

House and Senate accept conference report on federal-aid road authorization measure

Acceptance on June 1 by both House and Senate of a conference report on the federal-aid road authorization bill sent this measure to the White House for signature carrying total authorizations of only $158,500,000 for 1940 and $191,000,000 for 1941, as compared with the $238,000,000 annually now being expended. This represented, for the most part, acceptance by the House of reductions made in various classifications of funds by the Senate, although the totals for the federal-aid highway system and for secondary roads are slightly higher than the Senate figures. The bill authorizes expenditures by the federal government as follows:

The final bill is a compromise between the economy recommendations of President Roosevelt and the desire of many congressmen, particularly in the House, to continue road expenditures at an undiminished rate. It was accepted only after assurances by the Bureau of Public Roads that on Jan. 1, 1939 (when the Secretary of Agriculture will apportion the new funds to the various states) there will be available a carryover from previous apportionments of at least $80,000,000 for grants on regular federal-aid system, $20,000,000 for secondary roads, $30,000,000 for grade crossings eliminations, $4,000,000 for forest roads, $1,000,000 for public-land highways, $4,000,000 for national park roads, $9,000,000 for national parkways and $2,000,000 for Indian roads, a total carryover of $150,000,000 which will be available to supplement the reduced amounts authorized. In addition, a large part of the new relief program appropriation will be used in road and street construction.

In its final form the bill leaves unchanged the present penalty for diversion by the states of motor-vehicle and gasoline-tax revenue. A new and stiffer penalty clause increasing the possible maximum retention of federal funds from one-third to two-thirds of the state's allotment had been proposed by the House committee, eliminated by the House, and restored by the Senate. Also omitted are a Senate proposal that the Secretary of Agriculture be given the power to determine design standards; a House limitation of grade crossing funds to the federal-aid system only; and a Senate proposal to relieve states of the need for matching grants used for highway surveys. Retained in the bill are two new provisions, one directing the Bureau of Public Roads to report to Congress on the cost and feasibility of a system of toll superhighways, and the other directing the Secretary of Agriculture hereafter to approve "only such methods of bidding and such specifications of highway construction for the type or types proposed as will be effective in securing competion and conducive to safety, durability and economy of maintenance."

FEDERAL ROAD AID ALLOCATIONS

	1940	1941	Present amount
Federal aid system	$100,000,000	$115,000,000	$125,000,000
Secondary or feeder roads	15,000,000	15,000,000	25,000,000
Grade crossing eliminations	20,000,000	30,000,000	50,000,000
Forest roads and trails	10,000,000	13,000,000	14,000,000
Public lands roads	1,000,000	2,000,000	2,500,000
Natl. park roads and trails	4,000,000	5,000,000	7,500,000
Natl. parkways	6,000,000	8,000,000	10,000,000
Indian reservation roads	2,500,000	3,000,000	4,000,000

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St. Lawrence Treaty Again Revived

(*Continued from page 795*)

International Rapids section of the St. Lawrence River."

The Canadian Government is asked to agree to construct or arrange for the construction of work allocated to Canada and, not later than Dec. 31, 1949, to provide for the deepening of the Welland ship canal and for the construction of canals of the required depth in the Soulanges and Lachine sections of the St. Lawrence River.

The American Government will construct the works on its side of the international boundary and will provide funds for the construction of all works in the International Rapids section except a power plant and any side canals or locks that may be required on the Canadian side of the international boundary. It also agrees to complete works in the Great Lakes system above Lake Erie which will be needed for the 27-ft. waterway.

The Joint Board of Engineers placed the cost of a single-stage development in the International Rapids section at $203,000,000, with 1,160,000 hp. installed in the power plant, and at $238,400,000 for a two-stage development. Cost for similar development, but with the power increased to something over 2,000,000 hp., was put at $235,000,000 and $265,000,000.

The supplementary statement given out by the State Department in connection with the treaty points out that with the American Government providing the funds for construction and with Canada not committed to any power development until power is required, it will be possible for the State of New York to proceed with the development of 1,100,000 hp. at a cost of less than $8 per horsepower year.

Improvements at Niagara

Construction of remedial works above the falls at Niagara is called for, the cost to be shared equally by the two governments, in order to give a better distribution of water over the falls and at the same time check the present rapid erosion. Upon completion of the work, each country will be permitted to increase its power diversion by 5,000 sec-ft. during the period required for a study of the effect of the remedial works. Subsequently, the commission is to report to the two governments as to further necessary action. No definite provision is made for eliminating the present inequitable distribution of water diverted under the treaty of 1909.

Chicago diversion

Diversion of water from Lake Michigan through the Chicago Drainage Canal is limited to that set by the U. S. Supreme Court decree of April 21, 1930 (1,500 sec.-ft.). However, the United States Government is authorized to increase the diversion to meet an emergency, the amount so diverted to be subject to the findings of a board of arbitration.

Either country is authorized to divert water into the Great Lakes system and to use the equivalent amount of water for power development at the several power sites along the international border.

The provision for water diversion into the St. Lawrence system covers the plans of the Ontario government to divert water from the Albany River into Lake Superior, which additional water will produce from 100,000 to 150,000 additional horsepower at Niagara Falls.

The commission will undertake a study of the desirability of regulatory works to the Great Lakes system, and if required, will prepare plans for their construction and will recommend to the government as to the equitable allocation of costs.

• • •

Wreckers Begin Work In Red Hook, Brooklyn

Wrecking crews began June 1 to raze the first of the 161 buildings which cover the site of Brooklyn's $16,500,000 low rent housing development in the Red Hook section.

THE CURRENT TREND

This week's news of contract volume and construction cost factors

Construction Up 7 Per Cent

Gains in highways, earthwork and drainage, waterworks and public buildings bring public construction 25 per cent above 1937

The major engineering construction awards for 22 weeks of 1938, $1,077,115,000, are 7 per cent above the $1,006,635,000 reported for the corresponding 1937 period by *Engineering News-Record*. Private construction for 1938 to date, $448,880,000, is 11 per cent below last year, while public awards, $628,235,000, are 25 per cent above a year ago.

Of the public total, $527,820,000 is state and municipal, 25 per cent above 1937; and $100,415,000 is federal, 27 per cent above last year.

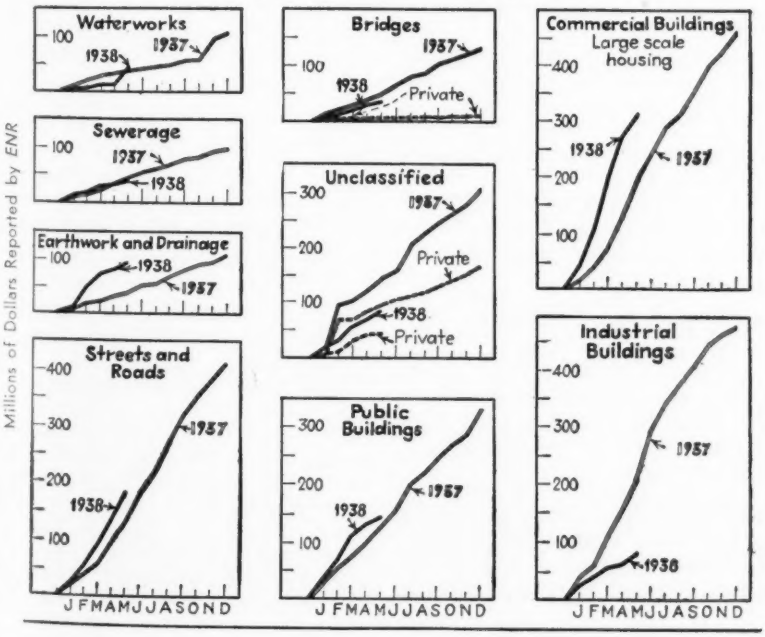
Public construction gain over 1937 is due to a 38 per cent increase in streets and roads; 16 per cent increase in waterworks; 132 per cent in earthwork and drainage; and 18 per cent in public buildings. City street improvements and state highway paving programs throughout the country cause the streets and roads gain; Grand Coulee high dam, Mississippi River dams, and large federal dredging projects keep earthwork and drainage more than double the volume of a year ago; Delaware Aqueduct awards are responsible for the waterworks increase; and Pennsylvania's institutional building program is largely responsible for the public building gain.

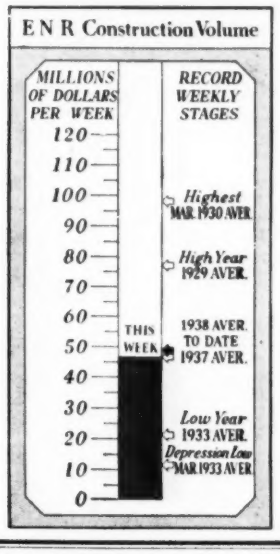
Commercial building awards, including large-scale housing, are 56 per cent above last year, but industrial buildings are 60 per cent lower and private unclassified construction is 52 per cent lower than the 1937 volume.

Geographically, the cumulative total through May for Middle Atlantic is 4 per cent above the 5-month volume for 1937; South is 15 per cent higher; West of Mississippi, 26 per cent higher; and Far West, 32.5 per cent higher; while New England and Middle West are 4 and 22 per cent lower, respectively, than a year ago.

New capital for construction purposes for the 22-week period, $679,126,000, is 18 per cent higher than in 1937. State and municipal bond sales for construction are 26 per cent above last year, and RFC loans are 113 per cent higher. There is, in addition, $53,493,000 in USHA loans and $86,532,000 in federal funds absent in 1937.

ENR CUMULATIVE CONSTRUCTION VOLUME BY CLASS OF WORK
1937 compared with 1938 to date





THIS WEEK'S FIGURES

(Thousands of Dollars)

CONTRACTS

	Week Ending June 10 1937	June 2 1938	June 9 1938
Federal	$5,052	$2,034	$5,435
State & Municipal	20,676	32,679	32,303
Total public...	$25,728	$34,713	$37,738
Total private..	17,155	10,537	9,699
TOTALS	$42,883	$45,250	$47,437

Cumulative
1938 (23 weeks).....$1,124,552
1937 (23 weeks).....$1,049,518

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000 other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1937 23 Wk.	1938 23 Wk.
NON-FEDERAL	$580,886	$661,413
State & Mun. bonds...	243,013	308,263
Corporate securities...	267,085	176,224
PWA loans, grants....	40,849	2,036
RFC loans	29,939	63,820
U.S.H.A. loans	.....	111,070
FEDERAL	.....	$86,532
TOTAL CAPITAL	$580,886	$747,945

FHA MORTGAGES

	Cumulative 1937 22 Wk.	1938 22 Wk.
Mortg. selected for appraisal	$290,030	$369,831

ENR INDEX NUMBERS

Index Base	1913	1926
Construction Cost (June)...	236.86	113.86
Building Cost (June).....	198.22	107.15
Construction Volume (May)	167.00	73.00

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INDEX OF SHIPMENTS OF CONSTRUCTION materials stands at 64 for April, 1938, unchanged from March, 49 per cent above February, but 23 per cent below April, 1937 as reported by the PWA National Resources Committee.

FABRICATED STEEL PLATE ORDERS for April, 21,958 short tons, are 42 per cent below March, 1938, and 48 per cent below orders in April, 1937, according to the Bureau of Census. Orders for 1938 to date, 101,259 tons, are 46 per cent below the 4-month total for 1937.

Two Shasta Dam Bids Received

(*Continued from p. 795*)

Los Angeles; Shofner, Gordon & Hinman, Denver; W. E. Callahan Co. and Gunther Shirley Co., Dallas; A. Guthrie & Co., St. Paul, Minn.; L. E. Dixon Co., Los Angeles; and Hunkin-Conkey Co., Cleveland.

Stockholders of the Shasta Construction Co. are J. F. Shea Co., San Francisco; MacDonald & Kahn Co., San Francisco; Morrison-Knudsen Co., Boise, Idaho; General Construction Co., Seattle; Pacific Bridge Co., San Francisco; Guy F. Atkinson, San Francisco; Walsh Construction Co., Davenport, Iowa; Henry J. Kaiser Co., Oakland; Utah Construction Co., Ogden.

Walker R. Young, construction engineer of the Central Valley project, says both bids will be considered before a contract is awarded by the Secretary of the Interior, and that the contract may be awarded in time for work to be started by Aug. 1. The specifications provide that the successful bidder must start work within 30 days after receipt of an official notice from the government to proceed. The contractor will be allowed 2,000 working days, or about 5½ years, to complete the job. Liquidated damages for delay will be assessed the contractor at the rate of $2,000 a day.

Dam features

Shasta Dam will be erected across the Sacramento River Canyon about 12 miles north of Redding, Shasta County, Calif. It will be a gravity section concrete dam, about 560 ft. high and 3,500 ft. long, with a slightly curved axis, an overflow spillway in the center, and a 350,000-kw. power plant flanking the base. It will back up the waters of three rivers—the Sacramento, Pit and McCloud—a distance of 35 miles to create a reservoir with a gross storage capacity of 4,500,000 acre-ft.

A full account of the dam's features, "Bigger Than Boulder," may be found in *Engineering News-Record*, May 5 1938, p. 647.

The bids just received are for performing all work, including furnishing labor and equipment, and for construction of the dam and power plant. The bids do not include the supplying of material which is to become a part of the completed structure. The government will purchase under separate contract such items as cement, structural and reinforcement steel, pipe, metal work and machinery.

Some items selected from the unit bid schedule are as follows: 1,500,000 cu.yd. of rock excavation for foundations; 960,000 cu.yd. of rock fill on upstream slope of embankment; 1,500,000 cu.ft. of pressure grouting; about 370,000 lin.ft. of drilling, including exploratory holes, grout holes, inspection holes, etc.; 5,400,000 cu.yd. of concrete in the dam; 26,000,000 lb. of reinforcing steel.

PERSONAL

H. S. GEISMER, recently PWA director of Alabama and formerly a member of the Birmingham firm, Keiser-Geismer Engineering Co., has been appointed to represent the state of Alabama in Washington in negotiations for WPA projects.

RALPH P. RAMSEY has been appointed acting project manager at Ottawa, Kansas, for the U. S. Soil Conservation Service.

M. H. BRYANT has been made county engineer of Appanoose County, Iowa, succeeding the late T. E. Lusk.

LEWIS VAN CARPENTER, a professor at New York University since 1935, has been made director of the new sanitary engineering laboratory established there last fall in cooperation with the city of New York. Before joining the N.Y.U. faculty, Carpenter taught at West Virginia University.

R. B. ALEXANDER, resident engineer for the Texas highway department, who has had charge of the Galveston causeway, now approaching completion, has been transferred to supervise construction of the Trinity River bridge at Fort Worth.

MAJOR WALTER L. MEDDING of the U. S. Engineers, who has been an instructor in the National Guard at Cambridge, Mass., has been transferred to the Memphis Engineer District.

LESLIE G. HOLLERAN, chief of the planning section of the New York City WPA, has resigned that position to go to the Metropolitan Life Insurance Co. for work on its new housing development in New York City.

EDWARD ANDERBERG, deputy chief of the planning section of the New York City WPA, has been appointed chief of the section, succeeding Leslie G. Holleran.

C. F. ROBINSON, chief of the field inspection and safety section of the New York City WPA, has been appointed deputy director of operations.

H. T. HEALD, professor of civil engineering and dean of Armour Institute of Technology, has been elected president of the institute. Heald is a graduate of Washington State College. He joined the Armour faculty in 19[illegible] as assistant professor of civil engineering.

CAPT. C. H. MASON of the Corps of Engineers has taken over his new duties as administrative assistant to the district engineer of Jacksonville. Captain Mason graduated from West Point in 1925 and later took graduate studies in engineering at Cornell University.

FRANK F. WISE has been transferred from the engineering and construction division of Koppers Co. at Pittsburgh to the position of general manager of Koppers' Western Gas Division. Wise is a graduate in civil engineering at Carnegie Institute of Technology, class of 1916.

HAROLD O. CHURCH has been appointed city engineer of Zanesville, Ohio, succeeding G. R. Evans, who resigned some time ago.

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New Housing Contracts Announced by USHA

Additional loan contracts covering low-rent housing developments in eight cities with a total estimated project cost of $63,974,452, involving loans by the U. S. Housing Authority of $57,577,000, were announced June 3 by Administrator Nathan Straus. Details are as follows:

City	Total Cost	Federal Loan	No. of Families	Construction Cost per family*
Allentown, Penna.	$1,607,000	$1,446,000	322	$3,258
Baltimore, Md.	18,462,400	16,616,000	3,042	3,565
Birmingham, Ala.	4,253,071	3,828,000	860	3,287
Buffalo, N. Y.	4,047,651	3,643,000	696	3,643
Cleveland, Ohio	10,170,000	9,153,000	1,804	3,675
Columbus, Ohio	2,097,330	1,888,000	456	2,761
Detroit, Mich.	15,841,000	14,257,000	2,753	4,075
Pittsburgh, Pa.	7,496,000	6,746,000	1,256	3,560
	$63,974,452	$57,577,000	11,189	

*Excludes all costs but construction.

This group of contracts, added to the lists announced on March 17 and April 19, brings the total amount of federal loans for low-renting housing developments to $111,070,000, which are planned to house 20,833 family dwelling units.

It is Administrator Straus' present hope to announce additional contracts at the rate of approximately $50,000,000 per month until funds are exhausted.

American Delegates Named For World Road Conference

Official delegates who will represent the United States at the eighth International Road Congress, to be held at The Hague, Netherlands, June 18 to July 2 were named June 1 by the department of state. The chairman of the delegation will be Thomas H. MacDonald, chief of the Bureau of Public Roads; other members are Robert B. Brooks, of the Missouri Highway Commission; T. H. Cutler of the Kentucky Highway Department; J. S. Helm of the Asphalt Institute, New York; Thomas P. Henry, American Automobile Association, Detroit; F. C. Horner, Automobile Manufacturers Association, New York; C. Donald Kennedy, Michigan Highway Department; Murray D. Van Wagoner, president of the American Road Builders Association; J. Borden Weeks, American Motorists Association, Philadelphia.

• • •

Tunneling Record Again Set On San Jacinto Tunnel

Establishing a new excavation record for the second successive month, hard-rock crews on the San Jacinto tunnel of the Colorado Aqueduct drove 2,237 ft. of main heading during the month of May. Excavating at four faces (Cabazon west, Lawrence east and west, and Potrero east) the tunnel crews averaged better than 72 ft. per day and added 168 ft. to their previous best record made in April.

The distance remaining between the Cabazon and Lawrence headings June 1 was 1,992 ft. Based on current progress, it is expected that this leg of the tunnel will be holed through during July. On the same date, approximately 6,700 ft. remained to be driven between the Lawrence and Potrero headings. A total of 60,119 ft. of the 13.04-mile tunnel has now been excavated.

• • •

Arkansas Railroad Track Damaged by Storm

A storm that struck in the vicinity of Eureka Springs, Ark., May 29, damaged 18 miles of track between Eureka Springs and Beaver on the Missouri and North Arkansas River Railroad. Five miles of the line was washed out completely and 12 bridges and trestles were destroyed.

Within the city of Eureka Springs, damage was heavy, roofs of residences being pounded in by hail, windows broken and automobiles battered by the hail. Flood water washing down the mountainside undermined house foundations and filled paved streets with gravel.

Massachusetts Road Aid Cut

Diversion causes Department of Agriculture to reduce apportionment for 1938

The Department of Agriculture has announced its findings that Massachusetts has diverted state motor vehicle revenues to other than highway purposes in such a manner as to make necessary the withholding of $472,862 of the federal-aid apportionment of $3,171,423 for the fiscal year ending June 30, 1938. This action is made mandatory by the Hayden-Cartwright act of 1934 which requires that federal-aid funds be withheld from any state using the proceeds of state motor-vehicle registration fees, gasoline taxes and other special taxes on other motor-vehicle owners and operators for other than highway purposes in an amount greater than was being used prior to June 18, 1934. The amount to be withheld may not exceed one-third of the apportionment for any fiscal year.

Massachusetts authorities were notified in October, 1937, that a study of the state's disposition of motor vehicle revenues disclosed an increased use for non-highway purposes subsequent to June 18, 1934. The state was called upon to show why a penalty should not be applied. A showing that could be accepted under the provisions of the law has not been made and the funds in question have not been restored for highway use.

Under similar circumstances $250,000 was deducted from the apportionment to New Jersey for the fiscal year 1937. Maryland, Pennsylvania and Georgia were found to have used motor vehicle revenues for non-highway purposes to such an extent as to require federal action. Maryland and Pennsylvania have restored the required amounts to highway funds and no further action is to be taken. Georgia officials have given assurance that they will follow a similar course but have not yet done so.

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M.I.T. Engineering Dean Named Institute Head

Vannevar Bush, vice-president and dean of engineering of the Massachusetts Institute of Technology, has been elected president of the Carnegie Institute of Washington, succeeding John C. Merriam. He will take office January 1, 1939. Bush has been a member of the faculty at M.I.T. since 1919, a professor since 1923 and vice-president and dean of engineering since 1932.

Chevalier Made Publisher Of Business Week

Willard Chevalier, vice-president and publisher of the construction and mining papers of the McGraw-Hill Publishing Co., has been appointed publisher of *Business Week*. H. W. Clarke succeeds Chevalier.

Chevalier came to the McGraw-Hill Publishing Co. in 1922 as an associate editor of *Engineering News-Record*. He was appointed business manager in 1923 and publisher of the construction papers in 1927. In 1934 he was elected vice-president and director of the company and became publisher of its four construction and mining papers.

Chevalier is a graduate in civil engineering from Brooklyn Polytechnic Institute. Previous to coming to *Engineering News-Record* he was with the Consolidated Telegraph & Electrical Subway Co., the N. Y. Public Service Commission, the Atlantic Gulf & Pacific Co., the American Bitumastic Enamels Co. and its successor, the Wailes Dove-Hermiston Co. During the World War he served with the 11th Engineers in France. During recent years he served as president of the Water Works Manufacturers Association and the American Road Builders Association. He now is a director of the latter organization and of the American Water Works Association.

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Arkansas Suit Tests Legality Of Taxing PWA Material

A test suit to collect the two per cent state sales tax on money spent for material for a public works administration project, has been filed in Pulaski, Ark., Circuit Court by Jack Holt, Arkansas Attorney-General. C. R. Carty, Little Rock contractor, who built an addition to the Benton, Ark. high school as a PWA project early in 1937, has been named defendant. The suit asks $319 from Carty—two per cent of the total of $15,951 spent for materials on that job.

Similar claims, involving a total of more than $10,000 are pending against 11 other contractors. The complaint filed by the state alleged that Mr. Carty had refused to pay the tax on the ground that the Benton high school and the PWA were subdivisions of the government and thereby exempt. Attorney states that the legal question involved in the suit is whether the state can collect the sales tax on all money spent for material, or whether the tax can be collected only on materials bought with 55 per cent of the money put up by the sponsors.

Senate Passes Relief Bill

Measure now goes to conference with House for adjustment of differences

Having made many changes and additions, the Senate on June 3, by a vote of 60 to 10, passed the 1938 relief and recovery bill and sent it to conference with the House for the adjustment of differences. These did not include a provision added to the bill by the Senate appropriations committee barring PWA power loans to municipalities now served by privately-owned utilities subject to regulation. This was voted down by the Senate after bitter debate on the assurance of majority leader Barkley that the President has no intention of approving such loans until the municipality in question has made a bona fide offer to purchase existing facilities at a fair price.

To the four titles in the bill as it passed the House, the Senate added two more: One appropriating $212,000,000 for parity payments to farmers; the other amending the slum-clearance act to increase the maximum loaning power of the U. S. Housing Authority from $500,000,000 to $800,000,000.

Major points of difference between the House and Senate versions of the bill, which must be adjusted before final enactment, are in part as follows:

Title I—The House appropriated $1,250,000,000 for WPA for the first seven months of the fiscal year. The Senate increased the period to eight months and the amount, correspondingly, to $1,425,000,000. The Senate also authorized the WPA administrator to set aside not more than $125,000,000 of his appropriation as an emergency fund for direct relief. The Senate also increased the appropriation for the National Resources Committee from $250,000 to $750,000, and inserted in the bill provision that WPA shall not pay a lower wage rate than $40 per month, nor less than may be prescribed for private employers by the prospective wage-hour bill. WPA workers are to be required to submit quarterly statements of outside earnings while on WPA rolls. Project costs aside from wages are limited to an average of $7 per worker.

Title II—The House extended PWA to June 30, 1940, with a new appropriation of $965,000,000 and permission to use $500,000,000 as a revolving fund for further loans. The Senate extended the time to June 30, 1941, left the principal amount unchanged, but reduced the revolving fund to $400,000,000. Both limited the amount available for grants to $750,000,000. Allotments to federal projects were limited to $100,000,000 by the House; increased to $200,000,000 by the Senate. House deadlines were: on applications, Sept. 30, 1938; for starting construction, Jan. 1, 1939; for completion, June 30, 1940. Corresponding Senate deadlines are: Sept. 30, 1938; March 31, 1939; Sept. 30, 1940. Sen. Norris proposed an amendment, which was accepted, exempting projects under injunction from the final deadline. The Senate also deleted the House provision that authorized PWA to build and rent facilities to political subdivisions unable to participate on the usual loan-and-grant basis.

Title III—This increases the total authorization for public buildings outside of the District of Columbia for the three-year program set up in August, 1937, from $70,000,000 to $130,000,000 (House) or $100,000,000 (Senate). It also appropriates $25,000,000 to be immediately available.

Title VI—Added to the bill at the suggestion of Sen. Wagner, this section adds to the relief bill a pending proposal to amend the slum-clearance housing act. Maximum loan authorizations by USHA are increased from $500,000,000 to $800,000,000 and the agency is empowered to advance 100% of the cost of a project to the local housing authority during the period of construction. This loan must be reduced, however, to a 90% basis (as under the present law) before any rental subsidies can be paid by the federal agency. The effect of this change is to defer until the end of the construction period the time when the local contribution must be provided.

All attempts to earmark relief money for specific purposes were defeated by the Senate on the plea that, to meet the exigencies of unemployment, complete flexibility is needed by the executive department. Among such proposals were two by Sen. Copeland of New York. One of these would have earmarked $324,235,900 for a long list of flood control and navigation projects; the other would have reserved $84,551,248 for army post housing.

The bitterest battle was over an amendment proposed by the Senate committee that would have prohibited PWA allotments for the construction of any income-producing projects competing with existing public utilities subject to public regulation. It was pointed out immediately that this wording was so broad as to exclude practically every utility project. A proposed compromise requiring that no allotment be made until a fair price had been offered for existing facilities met with the objection that it would subject every such project to legal delay, since the competing private utility would undoubtedly demand a court review of the fairness of the price.

Sen. Barkley then stated that, after a conference with the President, he was authorized to state that no power allotment would henceforth be approved until the applicant had, in good faith, made an offer to purchase existing facilities at a fair price. This policy, he said, would ensure protection to investors, but could not be written into the law without opening the door to litigation and delay. He suggested defeating the amendment on the understanding that this policy would be followed.

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Edward N. Hines Dies

Edward N. Hines, highway commissioner of Wayne County, Michigan, for over 30 years, and early advocate of concrete for roads, died June 4 in Detroit. A fuller account of his activities will appear in these pages next week.

OBITUARY

ANDREW WILLIAM NELSON, 80, retired general contractor of Seattle, Wash., died there May 19.

SAMUEL J. RUTHERFORD, 68, engineer and vice-president of the York Engineering Co. and former president of the Toronto Plate Glass Co., died recently in Toronto.

CLARENCE C. BAKER, a civil engineer with the New York State highway department, died May 30 at Highland, N. Y.

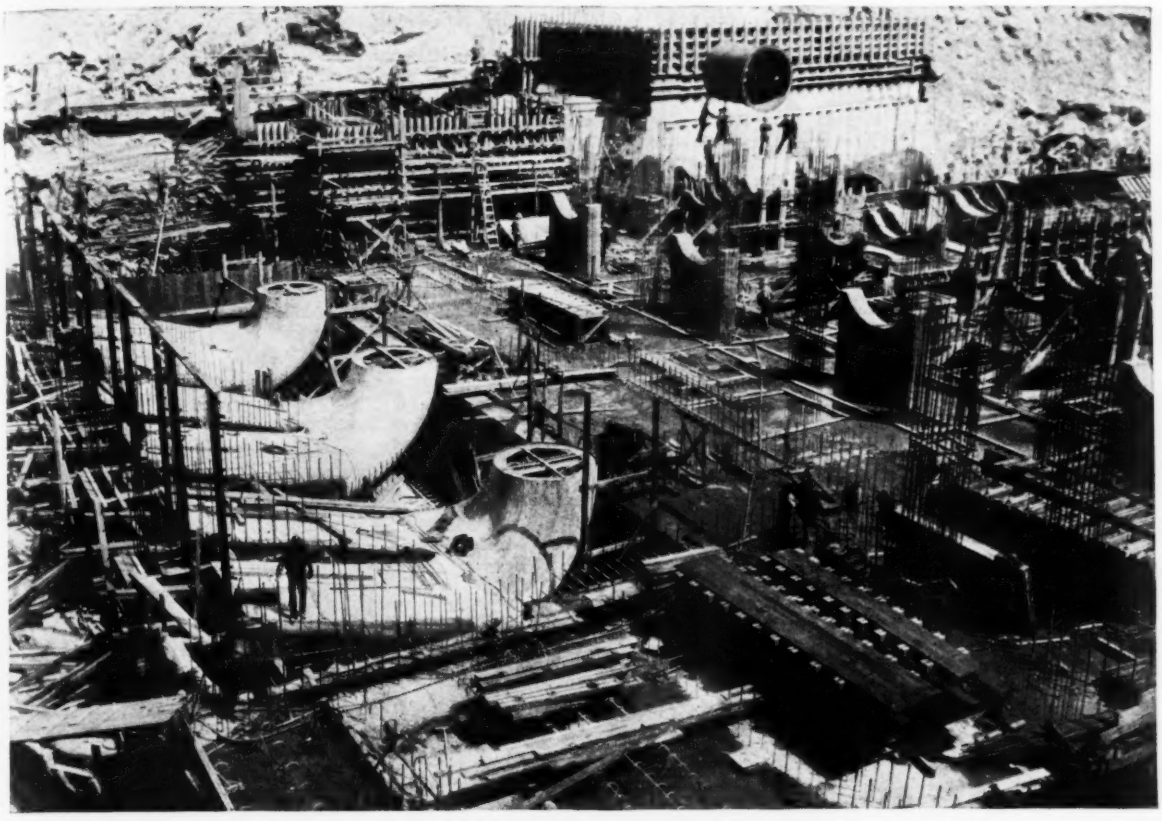
WINTHROP SLADE, superintendent of the Boston Bridge Works for 25 years prior to his retirement some years ago, died in Cambridge, Mass., May 21.

SAMUEL SUMNER EDMANDS, director of the School of Science and Technology at Pratt Institute, died in New York recently as a result of injuries received in an automobile accident on the Henry Hudson Parkway. Edmands was 61.

CHARLES S. MACKENZIE, once city engineer of Preston, Ont., and more recently general manager of the Link Mfg. Co., Ltd., died May 24 at Gananoque, Ont.

HENRY D. JOYCE, 72, for many years mechanical superintendent of the department of public works, Buffalo, died there May 21.

EDMUND CONWAY, railway builder and contractor, died in Quebec May 25 at the age of 81. Conway built the Lake St. John Railway, and is credited with the invention of the snow plow now in use in most North American cities.



CONSTRUCTION AT SEMINOE DAM

DRAFT TUBE FORMS for the powerhouse below Seminoe Dam of the Kendrick (Casper-Alcova) Bureau of Reclamation project were set in May, and the first section of 120-in. penstock pipe is shown being lowered into place on one of the reinforced concrete saddles which are being constructed for that purpose.

Treasury Asks for Bids On Low-Heat Cement

Continuing its centralized cement buying program, the Procurement Division of the U.S. Treasury has asked for bids to be opened June 13 in Washington, D.C., for two lots of low-heat portland cement totalling 7,800,000 bbl. to be used in the state of Washington. As usual, prices are to be quoted f.o.b. cars or trucks at production point.

Bids are asked on two schedules, one covering 2,000,000 bbl. to be delivered between August, 1938, and June, 1939; the other 5,800,000 bbl. for delivery between August, 1938, and October, 1941. There is no direct indication as to whether these are alternative or complementary purchases, but in each case delivery schedules are identical for the common period, being set at not to exceed 15,000 bbl. per day or 400,000 bbl. per month.

In accordance with the usual policy no official indication is given as to the location of the job where this cement will be used, but the quantities involved point directly at Grand Coulee Dam.

As the result of previous bid openings, contract awards have been made for cement requirements in a number of states where competitive bids have been obtained. With each award information as to the point of use becomes available. A summary of these awards is given in the table.

No awards have been made, nor have new bids been called, in a number of regions where bids were either unsatisfactory or non-existent. These include New Jersey, West Virginia, Ohio, Texas and New Mexico.

State	Point of Use	Quantity (bbl.)	Price	Award to	Point of delivery
California	Los Angeles Co. (Corps of Engrs.)	250,000(1)	$1.63(d)	Monolith P. C. Co.,	Monolith, Cal.
Oregon	Reedsport (Army)	2,500(2)	2.00(d)	Oregon P. C. Co.,	Lime, Ore.
Utah	Ogden (Army)	2,418(3)	2.60(d)	Union P. C. Co.,	Devils Slide, Utah
Colorado	Fort Logan (Army)	2,160(3)	2.25(d)	Colorado P. C. Co.,	Portland, Colo.
Wyoming	Shoshone Project (Bur. of Recl.)	35,000(2)	2.20*	Monolith Portland Midwest Co.,	Laramie, Wyo.
Montana	Sun River Project (Bur. of Recl.)	6,000(4)	2.50(d)	Three Forks P. C. Co.,	Trident, Mont.

(1) Moderate-heat-of-hardening cement.
(2) Sulfate-resisting cement.
(3) Normal portland cement.
(4) Finely-ground portland cement.
(d) Discount of 10c. per bbl. for prompt payment.
* In cloth; allowance of 50c. per bbl. for returned sacks.

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Zoning Commissioners Resign in a Body

Resignation en bloc of members of the Houston Zoning Commission has been submitted to the city council, following the council's failure to appropriate further funds for zoning. Zoning engineers have been ordered by the Zoning Commission to turn all zoning maps over to J. M. Nagle, city public works director.

The action was taken following a strenuous fight in Houston over the principle of municipal zoning, which its proponents claim to be an essential factor in city planning. Houston is the only large city, with the exception of Detroit, without zoning laws. Members of the Zoning Commission include: Hugh Potter, John A. Embry, C. C. Fleming, J. Frank Jungman, Dr. J. Allen Kyle, J. Robert Neal, and John F. Staub.

British Engineers Plan New Guild

Unity of action on public and professional matters to be fostered by The Engineers Guild

British engineers, at a meeting held in Westminster on May 16, decided to proceed with the organization of a professional body open to corporate members of the four major institutions of civil, mechanical, electrical engineers and naval architects. The object of the guild will be promotion of the social and economic welfare of engineers, stimulation of service to the public by the profession, development of unity within the profession, and promotion of the efficiency of members.

The action taken on May 16 was the outgrowth of the appointment of a committee last November to study how the profession could be unified and its public service improved. That committee submitted a majority report proposing the establishment of the guild with membership open to members and associate members of the four institutions and to graduates in engineering of British universities. A minority report recommended the setting up of the "Association of the Engineering Profession" with membership limited to the four founder institutions. The meeting decided to proceed with the formation of The Guild of Engineers on the basis of the temporary constitution and by-laws appended to the report, but decided to limit membership to the four founder institutions.

Commenting on the organization of the new Guild, *The Engineer*, London, points out that the engineering profession in Great Britain has no agency through which it can express a common voice. There is a body called the Engineering Joint Council concerning which *The Engineer* says "It is a wholly ineffective body, without money, without power, and continually baffled by internal differences which the impolite call institutional jealousies."

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Mall Tool Company Denies Trade Commission Charge

The Mall Tool Co. of Chicago has entered with the Federal Trade Commission a complete denial of the commission's formal charge that it is "passing off a 2-hp. product manufactured by another company as a 3-hp. product" manufactured by the Mall Co. (*ENR* May 26, p. 735). The Mall Tool Co. advises us that it anticipates that it will be completely absolved from the charge following hearings, which should begin at an early date.

Health Commission Acts Against Niagara Pollution

The cities of Tonawanda and North Tonawanda, N. Y., have been ordered by the New York State Commissioner of Health to show cause at a hearing June 13 why they should not be compelled to stop polluting the Niagara River with sewage. The orders are designed as a final step in a general program for elimination of pollution in the Niagara River.

The present orders are similar to those served on the city of Buffalo in 1933 which led to the program of interception and treatment of sewage in a $15,000,000 program now nearing completion. Niagara Falls has already constructed a disposal plant which will soon be in full operation.

CALENDAR OF MEETINGS

NATIONAL SOCIETIES

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Chalfonte-Haddon Hall, Atlantic City, June 27-July 1.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, annual meeting, Texas A. & M. College, College Station, Texas, June 27-30.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, summer convention, Washington, D. C., June 20-24.

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual convention, Hotel Utah, Salt Lake City, July 20-22.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Pacific Coast convention, Portland, Aug. 9-12.

AMERICAN SOCIETY OF PLANNING OFFICIALS, Minneapolis, June 20-22.

PUBLIC HEALTH BACTERIOLOGY, summer course, Massachusetts Institute of Technology, Cambridge, June 13—July 22.

A.S.M.E., semi-annual meeting, hydraulic section, Hotel Statler, St. Louis, June 21.

AMERICAN WATER WORKS ASSOCIATION, Central States Section, Hotel Windsor, Wheeling, W. Va., Aug. 17-19.

ELECTIONS AND ACTIVITIES

OFFICERS of newly organized Engineers Club of Western North Carolina are as follows: President, Paul W. Frisk; vice-president, Joe Dave; secretary, M. O. Jensen; treasurer, D. E. Stewart; directors, Joe Gill, E. D. Burchard, Charles E. Waddell and R. L. Maynard.

WASHINGTON HIGHLIGHTS

Special reports by Paul Wooton

GOVERNORS of states in the Colorado river basin have been requested by the State Department to submit suggestions in connection with the treaty that is to be negotiated with Mexico as to the use of waters of the Colorado and Rio Grande rivers. Additional Colorado river water is being put to use rapidly in Mexico. Unless a treaty is negotiated before the low water flow of the Colorado is increased further, serious difficulties between the two countries are foreseen.

WITH construction work about to start on the 40-mile stretch of the Coachella canal recently advertised there is additional support for the estimate that the All-American Canal will begin delivering water for the Imperial Valley project early next spring. The work on the canal and dam is about ten per cent ahead of schedule.

HOUSING is the best looking object in the business picture, as Washington sees it. Residential building in May is one activity that shows up as well this year as in May of 1937. While the bulk of capital issues awaiting approval are for such refunding purposes, means reduced costs and so should help business to some extent.

MORE significant than is any development in the field of business during this calendar year, Washington thinks, is the determination of the administration to spend a large proportion of the year's relief money during the next six months. Expenditures by the Works Progress Administration are to be speeded up sharply throughout the summer and autumn with the idea of getting the maximum amount of federal money into the channels of business and trade during the period that the Public Works Administration and other agencies are preparing to get into action. The administration realizes that one of its highest hurdles is to get the pump-priming money out quickly.

Some disappointment is being expressed because RFC loans are lagging. Despite a disposition to be liberal, RFC officials are faced in each instance with time-consuming investigations. The desire to have local banks or other local interests take participations in industrial loans means long-range negotiations that cause further annoying delay.

COMMENT AND DISCUSSION

Readers' opinions on matters that concern the engineer

Cement-Bar Ratio

Sir: The question is raised in your issue of May 19 (p. 699) as to why there has been such a wide variation in the relation of cement production to reinforcing bar production since 1929. Previous to 1928 the average ratio of tons of bars to 1,000 bbl. of cement was below 5, and since 1929 it has increased to 5.7.

Is it not safe to assume that the average for the period before 1929 does not give an accurete picture of what the relation should now be, and that the erratic record since 1929, especially that of the past three years, is due to the fact that with our greatly reduced volume of construction any large job like Boulder Dam or Grand Coulee may produce a sharp change that would be offset by other factors in more normal times?

I do not have the facts before me to check, but is it not probable that under present conditions reinforced concrete makes up an abnormally large part of our total concrete production? We are not building many large dams, power plants or bridges having large masses of plain concrete. If the high peak of production at Boulder Dam fell in 1935 and the high peak at Grand Coulee in 1937, the ratio of 9.1 for 1936 would seem to indicate that such a high ratio is to be expected until we get back to the time when much more mass concrete is being placed annually.

GEORGE LYMAN
New York, June 4, 1938

Building on Soft Ground

Sir: Your editorial remark of June 2 (p. 770) that building a fill on soft ground at North Beach Airport "represents a new application of soil mechanics principles" apparently overlooked the work done at Flushing Meadows two years ago. At that site much of the subsoil is quite comparable with the soft and disturbed material at North Beach, having similar high water content and being in disturbed or "reworked" condition as the result of displacement and flow induced by earlier filling. To develop feasible filling methods for the preparation of the World's Fair site on the meadows all the principles and methods later utilized at North Beach were applied, I believe for the first time. Based on study of the structure of the silt, the method of placing fill on a very flat slope to avoid or control the development of mud waves was fully worked out there.

CARLTON S. PROCTOR.
Consulting Engineer
New York, June 6, 1938

Butt Welds in Tension

Sir: Regarding the editorial "Welding Not Discredited" in the May 5, 1938 issue, p. 642. "I agree fully with the statements made except "the use of butt welds in tension is placed under suspicion which needs to be removed if possible." The impression is that fillet welds should have been used either in compression or shear. For structures subjected to dynamic loading fillet welds have many objections; due to the reentrant angle, structures of this kind have a very low resistant to fatigue. Much has been said during recent years about the design of welds, and I think it is the consensus of opinion at the present time that butt welds should be used wherever possible. Of course, sometimes it is economically impossible to use butt welds, therefore, fillet welds are used on some bridges and most steel frameworks for buildings. So far as I know, good practice does not permit fillet welds in boilers or pressure vessels. Certainly the butt welds in these structures are under tensile stresses under operating conditions.

It is unfortunate that a statement of this kind should appear in the *Engineering News-Record* because it will be widely read and used to retard the use of butt welds.

H. L. WHITTEMORE
Chief, Engineering Mechanics Section
National Bureau of Standards
Washington, D. C., May 28, 1938

It is true that butt welds in tension are used extensively for the severe service of pressure vessels but such welds may be readily stress-relieved whereas this is difficult on bridge work. Other welding specialists have been known to disagree with the view expressed by Dr. Whittemore. The editorial in question argued no viewpoint, merely stated that the failure placed butt welds in main tension members under suspicion.

— EDITOR

Trained Bricklayers Needed

Sir: In my letter concerning the Locke Field Apartments published on p. 768 of your issue of June 2 I stated that one reason for trouble with brickwork today is the lack of properly trained bricklayers. We also lack men with proper knowledge of bricklaying in supervisory capacities. I will wager that not one of the experts that Mr. Straus sent to study the Locke Field Apartments was a practical "bricky."

The inspection of brickwork is often inexperienced and instead of the inspector working with the contractor to obtain the best results they will try to hold strictly to the specifications, by which a satisfactory wall cannot be built.

In over 30 years as an employer of labor I have not properly apprenticed one youth. Under the system in vogue the wages required to be paid eliminates the apprentice as a business proposition. I have two sons, 32 and 28 years respectively, the older a civil engineer and although they have both worked almost continuously in the construction field the union requirements are such that neither one will ever be a first class mechanic in any one line. Whoever said, "a little learning is a dangerous thing," was right.

I understand that there is a federal committee on apprentice training in Washington, D. C. If it is dominated directly or indirectly by the unions it cannot but be impractical and impossible in operation. A man must have many years practical experience in any line to be fitted and qualified to lay down rules that can be followed to apprentice a youth properly. In the contracting construction field the day of apprenticeship has passed. Youth will have to be trained for two years in a trade school at public expense so that when he goes into the field he will be able to earn enough to get by while he is improving his ability enough to earn the standard wage.

JAMES A. MUNROE
North Attleboro, Mass.

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JUNE 9, 1938

REVENUE BONDS for self-supporting public-service activities such as waterworks do not come within the debt-limit restrictions on city financing, the Utah Supreme Court has decided (ENR June 2, 1938, p. 761). The decision gives legal approval to the common-sense view that debt limits do not apply to capital invested in a revenue service. The contrary view has restricted the proper development of public-service facilities in a good many states and cities, and it is to be expected therefore that the Utah court's opinion will open the way to carrying out greatly needed improvements. It should also lead to adopting the system of service charges for some public services hitherto supported by the tax rate, as sewerage and refuse disposal. Of course it will be essential to establish the finances of any such service on an independent and self-contained basis, if revenue bonds are to command a proper market. This, however, will be wholly to the advantage of good management of the public business. Full application of the Utah decision will make possible distinct advance in the field of public works and services.

More Federal Control

STATE ENGINEERS interested in maintaining control over dams built within their state boundaries need to take notice of the Federal Power Commission's order relating to Possum Kingdom Dam in Texas. Following its consistent policy of continuously expanding its control, the commission in that order asserts its power to stipulate how the dam shall be built and maintained in the interest of public safety—even going so far as to specify maximum stress in concrete and steel. No justification for this part of the order can be found in the Water Power Act, nor is it even in line with the spirit of the act. Prescribing such conditions is a bold seizure of power—that of regulation in the interest of public safety—a police power which rests unquestioned in the states themselves. It is by an accumulation of just such isolated encroachments upon state authority that complete federal control ultimately is built up. Control over the design, construction and maintenance of dams is fundamentally a state function. It should remain under the state engineer or other competent state supervisory authority, and needless extension of federal control should be resisted.

Fewer Good Dam Sites

DAM BUILDING and design in the future are tending to become progressively difficult. In many valleys the best sites, especially those favored by unquestionably good foundation conditions, have already been built upon, and future dams will have to be accommodated to less-than-ideal foundations. Again, the purposes for which many modern dams are required place them in undesirable locations from the design and construction standpoint. For example, flood-control dams like Conchas, described in this issue, will not generally be in regions where good rock is available. Dams for recreation lakes, for navigation or for irrigation must likewise be located where needed, regardless of foundation conditions; many of the earth dams built in the past few years exemplify this fact. Poor foundations, of course, do not limit dam building or make dams built on them less safe. But they do make greater demands upon the knowledge and skill of engineers and contractors.

Program Problems

MUCH PROFITLESS REPETITION has come to characterize the technical proceedings of road-building associations, and its elimination represents one of the rather urgent program problems of the profession. In large part the repetition comes about because highway progress is marked by only a few outstanding developments in any year and each association feels the necessity of giving them recognition in its reports and discussions. But this duplication adds nothing to the information of the field. A specific example is soil stabilization for road bases and subgrades. In the half-dozen highway engineering meetings of the past season every method of soil or base stabilization was presented three or four times without adding an iota of information by the repetition. Joint planning of programs by association directors could do much to reduce this waste. Is it not time for program makers to study the possibilities of such planning and to find ways of bringing out new knowledge instead of repeating matter already brought out?

Nonessential Functions

AN IMPORTANT CHAPTER is added to the record of engineers' liability for federal income tax payment on money received from municipalities. In one wellknown case Metcalf & Eddy, Boston consulting engineers, were held liable for payment

on their fees where retained for a special structure or job and not in continuous service; in another W. W. Brush, chief engineer of New York City's Department of Water Supply, was held not liable, as being regularly employed in an essential governmental service. Now the United States Supreme Court has decided that employees of the Port of New York Authority must pay tax on their salaries, the work of the Authority being *not* an essential governmental function. The gist of the decision is that the function of the Port Authority is not essential to the maintenance of state government and could be carried on by private enterprise. Says the Court: "When immunity is claimed for a tax laid on private persons it must clearly appear that the burden upon the state function is actual and substantial, not conjectural". The decision indicates that the widening range of state and municipal activities of business character will not necessarily take rank as "essential governmental functions", and that engineers and contractors engaged in them will be subject to taxation in the same way as if they did private work.

An Empty Gesture

A DRAFT of another St. Lawrence Waterway treaty has been submitted to the Canadian government by the Roosevelt administration. Its coming was foreshadowed a few weeks ago when a Canadian proposal for a new agreement relating to power at Niagara was rather bluntly rejected by Secretary of State Hull, who stated that consideration of the question of power at Niagara is inseparable from power in the international section of the St. Lawrence River.

The new treaty is broader in scope than any existing or previously proposed Canadian-American treaty; it includes, in addition to power and navigation along the St. Lawrence, the matter of remedial works at Niagara Falls, more power development in the Niagara River, regulation of the levels of the Great Lakes and diversions into or from the Great Lakes drainage basin. Its content is not particularly important, however, for the treaty is bound to become nothing more than an empty gesture. Even though representatives of the two governments may go so far as to agree on details, as was done in the case of the ill-fated treaty of 1932, it stands no chance of being approved by the Senate in either country. The St. Lawrence deep waterway is more of a dream today than it was ten years ago when the Joint Board of Engineers outlined the plans on which the navigation features of the present treaty are based. There was then no sound economic justification for such a waterway and there is less today, due to the great decline in grain movements to Europe.

In Canada, where one of the two great railway systems is owned by the government, the people have come to the realization that every carload of grain loaded into foreign ships at Fort William on Lake Superior means just so many less carloads of freight handled on their railroads, so much less railroad income, and so many less jobs for Canadian railroad men. Nor do the Canadians yet need the power that can be developed along the International Rapids. Ontario would prefer to develop more power at Niagara, close to the industrial center of the province; Quebec can get cheaper power from the undeveloped streams within her own borders.

On this side of the border the treaty appears to have few friends other than the perennial waterway and public-power enthusiasts, the New York State Power Authority, and the President. Strongly opposed are all the Atlantic seaboard states that have ports which would stand to lose freight commerce to the St. Lawrence seaway. Also opposed are Chicago and those Mississippi Valley states which see a threat to the Mississippi waterway in the treaty's inclusion of a limit on diversion from Lake Michigan through the Chicago Drainage Canal. Thirty years ago Secretary Root, in negotiating the boundary-water treaty that was approved in 1909, successfully kept all reference to that diversion out of the treaty—although tacitly admitting its existence through giving Canada the larger share of water at Niagara. Many senators with no other interest in the treaty can be expected to take sides against abandonment of that old and firmly held tradition.

Quite general opposition in our Senate can be expected to the treaty's proposal that the funds for all work except power plants at the dams in the international section shall be provided by the United States. Obviously that proposal was put in as bait for the Canadians. They are told that if they will build those parts of the dams that lie on their side of the border, using their own men and materials, we will put up the money. That will not set well with many of our senators, nor with the people at large; appropriation of public funds for works outside our borders is not particularly popular.

Most of the works proposed under the treaty are not needed; no amount of fine words in the preamble and in the sales talk that the Administration put out with the treaty can conceal that fact. But remedial works to check the rapid erosion of the Horseshoe Falls at Niagara are needed, as is a reallocation of water for power production there. Hence it is to be hoped that the Canadian government will reject the proposal promptly, restating its interest in a limited treaty affecting the Niagara River. Such prompt rejection of a treaty that stands no chance of being ratified by either Senate may clear the way for a treaty that will accomplish immediately needed results.

PICTURES IN THE NEWS

Fairchild Aerial Surveys, Inc. L. A.

AN UNUSUALLY STRIKING EXAMPLE of inadequate provision for floods. This one is on the Santa Ana River in California. The flood channel between the parallel dikes had a capacity of only a few thousand second-feet and hence allowed the March flood, which exceeded 80,000 sec.-ft., to sweep unchecked over the entire valley.

ENR Staff Photos

PRINCIPALS at the TVA inquiry in Washington. Above is Arthur E. Morgan, deposed TVA chairman, and at left and right are David E. Lilienthal and Harcourt A. Morgan, who remained on the board when A. E. Morgan was removed.

Dam Building on Difficult Rock

Construction of Conchas Dam requires ingenious methods to support sliding shale abutments but work on the 235-ft. high concrete structure is progressing rapidly on the South Canadian River in New Mexico

TWO ELEMENTS of the current work on the 16-million dollar Conchas Dam, thirty miles northwest of Tucumcari, N. M., lend unusual engineering interest to the project. These are the methods being used to found the dam on a less-than-ideal rock foundation, which is the subject of this article, and the contractor's plant for concreting and aggregate processing, which is described in the article immediately following. The handling of WPA force account labor by the Corps of Engineers on some 10,000 ft. of earth dams and the construction town of adobe and stone buildings located 24 miles from the nearest railroad, which are other but less significant features of the job, also furnish new or important contributions to construction experience. The force account work will be covered in a future article, while the layout of the town and the design and construction of the buildings, which house a population of some 2500 people, were covered in an article in the issue of April 15, 1937, which also contained a description of the project and a discussion of the hydrology on which the design was based.

Conchas Dam is located on the South Canadian River about 1200 ft. below the confluence of the Conchas River. An irrigation and flood control project, most of its water will come from the South Canadian while most of its reservoir capacity will lie on the Conchas since the Canadian follows a deep narrow gorge just above the dam site. The project was designed and is being built under the direction of the Corps of Engineers, U. S. Army, and is scheduled for completion in the summer of 1939. At that time it will be available for 300,000 acre-ft. of irrigation storage below the overflow spillway in the main dam (for use in the 50,000-acre Arch Hurley Conservancy District recently formed in the vicinity of Tucumcari) and for 200,000 acre feet of storage above this spillway for flood control detention; floodwaters in excess of this storage will be passed over an emergency spillway (with a crest 17 ft. above the main dam spillway) provided in an earth dike about one mile north of the main dam. With this arrangement all but extreme floods will be kept to bankfull capacity below the dam. In addition to the flood control and irrigation storage there will be 100,000 acre-ft. of dead storage in the bottom of the reservoir, about one-half of which will be available for water supply to Tucumcari, Amarillo and other municipalities that may decide to connect a supply line to an outlet that is provided in the dam.

The main dam in the river canyon is a concrete gravity structure 235 ft. high and 1250 ft. long, with a crest at El. 4235, which is prolonged at either end by earth wing sections,

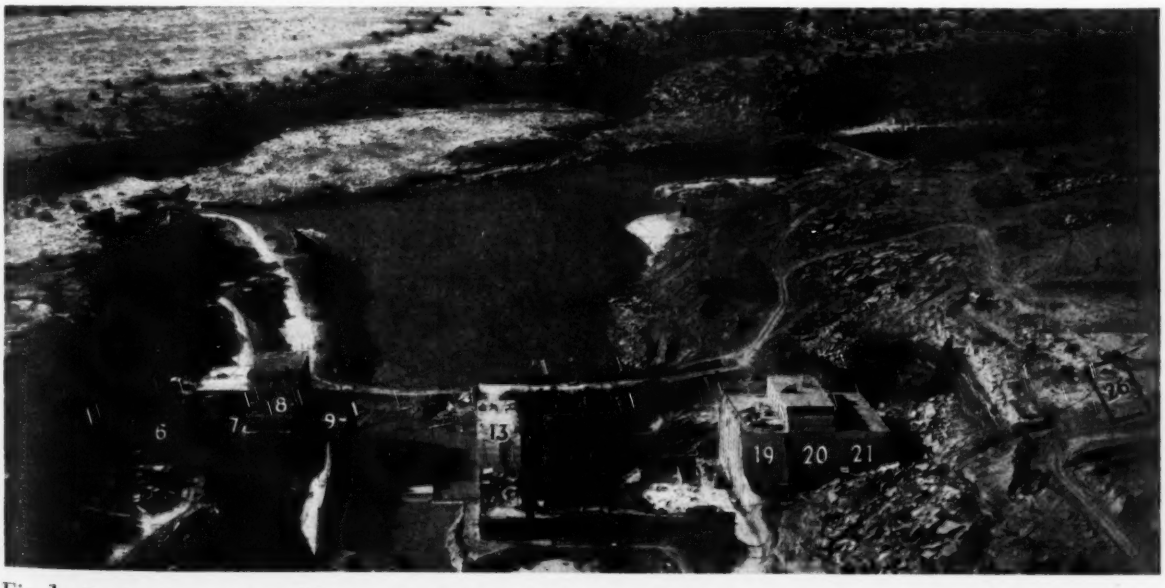

Fig. 1. **Conchas Dam at time slide in north abutment (right) caused change in construction plans. Location of monolith 26, now being constructed by shaft sinking procedure, is indicated.**

Fig. 2. Site map of Conchas Dam project in northeastern New Mexico.

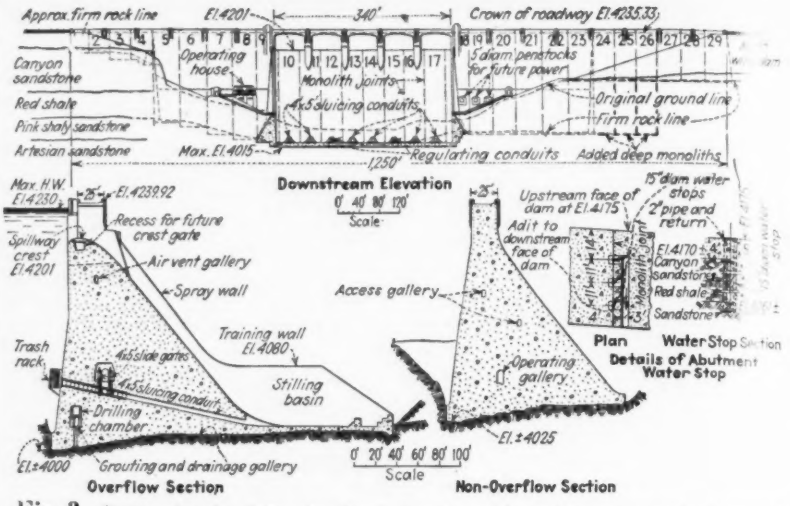

Fig. 3. Design details of Conchas Dam showing geological formation which created a difficult construction job at the shale face joint between the deep and shallow monoliths.

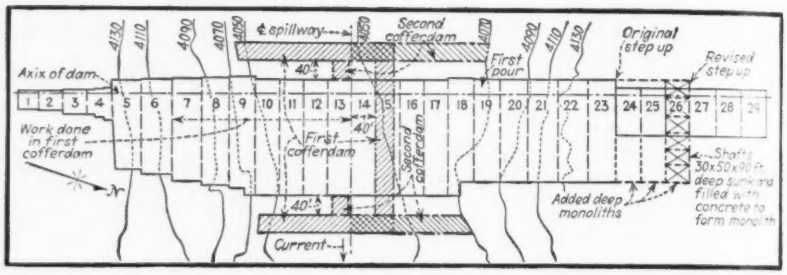

Fig. 4. Cofferdam layout for river section and shaft sinking plan for monolith 26.

1000 ft. long on the north and 4000 ft. long on the south. In addition, to complete the reservoir, earth dikes are required north and south of the wing sections as shown in Fig. 2. The south dike, 6400 ft. long and containing approximately two-thirds of all the earthwork on the project, accommodates the irrigation headworks (principally a 700-ft. concrete-lined tunnel) at its south end, while the north dike is separated into two sections, 1400 ft. long and 1150 ft. long, by the 3000-ft. concrete overflow emergency spillway. All earth dam sections are the same, consisting of an impervious rolled core, pervious rolled blanket and a rockfill surface both up and downstream. The maximum section, 92 ft. high, occurs in the south dike. The completed project will require the placement of 830,000 cu.yd. of concrete, 2,840,000 cu. yd. of rolled earthfill and 840,000 cu.yd. of rockfill.

Features of the dam

Foundation conditions at the site were an important consideration in determining the choice of a concrete gravity section, and were instrumental in fixing the cross-canyon profile. Thus, as shown in Fig. 3, a "canyon sandstone" near the surface is separated from an "artesian sandstone" beneath the river bed by 50 to 70 ft. of shales. Both sandstones are adequate, if not ideal, for the support of the dam and both are used, the center portion of the dam going to the deep rock while at the ends the base profile is stepped up to the canyon sandstone, the shale face at the step-up requiring careful sealing.

In general, the design follows conventional practice for similar irrigation and flood control dams. The center 340 ft. is occupied by an overflow spillway which terminates in an apron 127 ft. long equipped with dentated sills; although relatively short, this apron length was selected after model studies indicated that aprons up to 200 ft. long would provide no appreciable reduction in velocity and no improvement in the erosion profile beyond the end of the apron. For maintaining low-water flow in the river, and for draining the reservoir, six sluicing conduits, 4x5 ft. in section and equipped with slide gates, and two circular regulating conduits, equipped with 48-in. needle valves, are provided through the spillway to discharge tangent to the apron.

In the non-overflow section at the left of the spillway three 5-ft. diameter penstocks are provided for a possible future power generating installation, while in a comparable position at the right of the spillway is a 4-ft. diameter penstock for the future municipal water supply and a 2-ft. diameter penstock serving a turbine and 150-kw. generator for developing power for lighting and other service purposes; the generator as well as the water supply outlet are located in the operating house indicated in Fig. 3. The usual access, operating and grouting galleries are provided in the dam at various elevations, and provision is made on the spillway for the future installation of crest gates, which will permit an additional 100,000 acre-ft. of irrigation water to be stored.

For construction purposes, the dam was divided into monoliths 40 to 50 ft. wide and of full dam thickness, the joints between the monoliths containing vertical keys $5\frac{1}{2}$ ft. wide and 10 ft. apart to eliminate any possibility of the monoliths moving relative to one another. Waterstops at the upstream end of each of these joints consist of a 6-in. diameter hole (one-half in each monolith) flashed upstream by a 20-oz. copper sheet and filled with a special inter-

nal-set bituminous material. A much more elaborate water-stop is required to seal the joint at the shale abutment face at either end of the deep portion of the dam. As shown in Fig. 3, three 15-inch sealing wells are provided, half of each well being in the shale and half in the abutting monolith. The upstream and downstream wells of each group of three are filled with the special internal-set bituminous material and the center well is filled with bentonite, a material which will swell when wet and thus seal the well tighter if water gets to it. The wells filled with bituminous materials are provided with a 2-in. galvanized pipeline and return to permit heating the material with steam to effect a reseal if required. Frequent reheating will not be required, however, as the bituminous material selected remains plastic indefinitely at fairly low temperatures. The two downstream wells terminate in special galleries located above the shale while the upstream well is carried up to the top of the dam so that a seal between the canyon sandstone and the abutting monolith will be available.

With the exception of these water-stops, design details of the dam follow conventional practice.

Construction plan

Construction operations on the concrete dam, from their beginning in the fall of 1936 up until recent months when foundation difficulties were encountered at the shale abutments, have proceeded in accordance with the original plan and approximately on schedule. This plan as indicated in Figs. 1 and 4 was to enclose the south or right half of the site in a double-wall sheet pile cofferdam and proceed with the construction of monoliths 13 to 5. Concurrently, monolith 19 on the left or north bank of the river was built under the protection of some small earth dikes which kept the river out; when concreted above flood level this monolith gave protection to work on the remaining deep monoliths on the north bank.

Within the first cofferdam, monoliths 10, 11 and 12 were built up only to streambed level, so that an opening between monoliths 9 and 13 would be available for streamflow when the first cofferdam was removed and the remainder of the channel blocked by cofferdam 2. This latter cofferdam, using monolith 13 as its south side, enclosed the area for monoliths 14 to 18. When this stage of the work was reached, concreting operations were being carried on across most of the length of the deep portion of the dam. At present all monoliths from 6 to 22, except the three in the channel, are built up above flood danger and the second cofferdam is being removed.

During these stages of the operations, the principal difficulty encountered was the presence of water in the foundation rock, which it was found had been aptly named "artesian sandstone."

However, it was found that by drilling 8-in. holes into the strata and pumping from them with deep-well pumps, the artesian head could be materially reduced before excavation was commenced. During the final stages of excavation this deep pumping was supplemented by pumping of small diameter pipes grouted into the foundation at points where seeps appeared. With this procedure it was possible to lower the water table and control the inflow of artesian water so as to permit the completion of final excavation and the placing of foundation concrete with no great difficulty.

Because of this foundation condition, substantial drain outlets into a gallery near the upstream base of the dam are provided in the design, and in addition an extensive installation of pipes for measuring uplift after the dam is in service has been made. Grouting also may aid in controlling this water, and the heel grout curtain is being put in as the dam concrete rises. This consists of holes on 4-ft. centers, alternately shallow and deep (maximum 80 ft.). The shallow holes are drilled first and grouted at a conservative pressure, equal to 1 lb. per sq.in. per ft. of depth of hole and overburden, or a maximum of about 30 lb. per sq.in.

This shallow grouting is commenced at the fairly wide spacing of 32 ft. Holes at 16-ft. centers are then drilled and grouted, followed by the 8-ft. holes. The intermediate holes are left for deep grouting, where the same procedure is followed.

Except for a few holes, very little grout is being taken by the holes under this procedure. After completion of shallow grouting the deep holes are drilled and grouted under a higher pressure, still using the criterion of 1 lb. per foot of depth, or a maximum pressure of about 100 lb. per sq.in. Finally, after the dam is completed, and depending upon leakage and uplift measurements, additional holes may be drilled and grouted from the floor of the grouting gallery in which casings have been provided for this purpose.

Shale abutment difficulties

From the beginning, both the engineers and contractor had regarded the shale faces at the sides of the canyon as a source of possible difficulty. However, investigation had seemed to indicate that by painting them with an asphaltic material, these faces could be made to stand exposed for 60 to 90 days, or long enough to pour the concrete of monoliths 5 and 23 against them. However, in October, 1937, hardly a month afer stripping of the north

Fig. 5. Building monolith 26 in six sheeted shafts. Trusses support shaft bracing. One shaft is concreted to top. Tail tower of cableway in background.

abutment face had been commenced, it began to scale off and, in spite of various repair expedients, it finally slid into the hole excavated for monoliths 22 and 23.

Some change in plan was necessary and an interesting procedure was finally worked out that also involved a change in the design of the dam, namely, extending monoliths 24, 25 and 26 from their original foundation on the upper sandstone or caprock to the deep artesian sandstone. The altered construction plan then was to build monolith 26 first, by sinking a series of braced shafts. Such an operation would prevent the shale face from sliding and, after completion of monolith 26, excavation between it and the main dam could proceed by normal methods.

This construction plan is now being carried out. Work began by removing the overburden and blasting the layer of caprock, so that shaft excavation could start on top of the shale. The area of monolith 26 was then divided into six shaft sections, 30x50 ft. in plan, and alternate shafts are being sunk 90 ft. to grade and concreted before the adjacent shafts are begun. In order to avoid disturbance of the shale, excavation is by means of pneumatic air spades and chisels, and no blasting with dynamite or powder is permitted. The shafts are heavily braced with 12x16 and 12x12 timbers on 5-ft. centers vertically, the bracing being hung from trusses which span the top of the hole. Immediately upon exposure of the shale face it is protected by a coat of the special asphaltic material referred to above. The space between timbers is then lagged or sheeted. At present, about four and one-half shafts have been excavated and two have been concreted to the top of the shale.

Underpinning the caprock

A different and equally interesting procedure was used at the south abutment at monolith 5. Here, excavation had not exposed much of the shale face when the north slide occurred so that change in the dam design was unnecessary. However, the north abutment experience indicated that substantial support for the shale face was necessary, and the following procedure is being used.

Tunneling in under the caprock, 5x5-ft. shafts on 15-ft. centers were sunk 50 ft. through the shale to the more solid rock and filled with concrete and reinforced to act as columns subject to bending. Across the tops of these columns a heavily reinforced concrete girder was then cast. With the underpinning of the caprock thus complete, excavation of the shale in the area to be occupied by monolith 5 was begun. As this excavation exposed the concrete columns, reinforced concrete curtain walls were built between them to cover and hold the shale face, and in addition 12x16-in. timber braces were installed between the columns and the south face of monolith 6.

Although this substantial bracing might have held the shale face for its entire length, the contractor elected to build this monolith in three sections with two transverse joints. Only the upstream third of the excavation, therefore, was carried to grade initially. Also, as a further precaution, and since the monolith foundation was 18 ft. below the bottom of the underpinning columns, an earth and rock berm at the bottom of the columns and curtain wall (Fig. 6, left, bottom) was not excavated until after the concrete of the monolith had been built up to a substantial height. This berm of rock was then removed from beneath the monolith by tunneling from the next section and the hole filled with concrete from the top through a 42-in. "chimney" left in the monolith.

As an aid to this tunneling operation, and before the monolith concrete was poured, the berm was faced with adobe brick (which were available) and these in turn were covered with roofing paper. The blocks provided a cushion which the

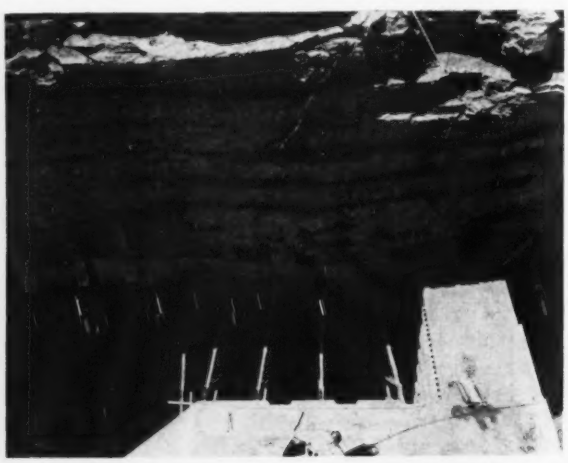

Fig. 6. Supporting the shale face at the south abutment. (Top) Sinking shafts for columns to support caprock underpinning. (Below, left) Building curtain walls on shale face as excavation exposes the columns previously sunk. (Below, right) Rear third of monolith poured.

pneumatic excavating tools in the tunneling operation would strike before coming in contact with the dam concrete, and the roofing paper eliminated bond between the concrete and the bricks.

As soon as the rear third of monolith 5 had been built up to the caprock, trucks and shovels came in from downstream to excavate the front area, and the procedure was repeated. Concrete is now being placed in the middle third of the monolith.

Conchas Dam was designed and is being built under the supervision of the Corps of Engineers, U. S. Army. For its construction a new district was organized with headquarters at the dam. Captain Hans Kramer is district engineer. Contract for construction of the main concrete dam and the adjacent earthwork dams is held by Bent Brothers, Inc., and Griffith Co., Los Angeles, L. T. Grider, general superintendent. The contract price is $4,587,676, and does not include the cost of the cement, which is furnished by the government.

Making Concrete for Conchas Dam

Modern group of equipment units includes 2-mile aerial tramway and two-tower cableway

To BUILD the 235-ft.-high gravity concrete dam of the Conchas project, described in the previous article, the contractor installed an unusually modern construction plant. In addition to the trucks and power shovels used for the major volume of the excavation, the principal plant units consist of a gravel washing and classifying plant about 2 miles east of the dam site and across the river, an aerial tramway to transport the aggregates, a batching and mixing plant at the dam site and two 15-ton cableways spanning the canyon.

In fixing the economical size of plant units to be installed for placing over 800,000 cu.yd. of concrete within the time limit allowed, the contractor selected a monolith section about half way up the dam to be poured 5 ft. deep in 8 hr. The yardage of this pour determined the need for two 15-ton cableways and for 4-cu.yd. buckets. Working back from the cableway gave a mixing plant with two 4-yd. mixers and the necessary aggregate and cement storage and batching equipment to service them.

The unique element of the plant design relates to the aggregate supply and storage and the supreme confidence the contractor places in the reliability of his 2-mile long aggregate tramway. Because of this confidence the major aggregate storage is maintained at the processing plant across the river, and only enough bin capacity (about 1000 cu. yd.) is provided at the plant for an 8-hr. run or for about 800 cu.yd. of concrete.

This aggregate processing plant is of the wet type. Material is secured from nearby shallow deposits of gravel which are found in separated spots and under about 8 ft. of overburden. These conditions, making the use of shovel loading uneconomical since the shovel would have to move a great deal, the contractor decided to use telescoping carryalls and tractors. These machines excavate the pits and haul the material to the processing plant where the loads are dumped on a grating over a hopper and slidetable feeding a conveyor belt that carries them to the top of the plant. The carryalls are of 14-yd. capacity and are equipped with 24-in. diameter tires. Experience has shown them to be economical for hauls up to 2000 ft. The tractors are run in high speed and, although the repair bills (mostly on the crawler treads) are higher than for trucks, the overall efficiency is found to be greater.

In the processing plant the aggregates are first scrubbed and then run through a perforated cylinder that rejects cobbles over 6 in. in size. From this cylinder the material drops onto three-deck vibrating screens for separating out the three sizes of large aggregates—6 to 2 in.; 2 to 1 in.; and 1 to ¼ in. The remaining fine material is run into a tank where the two sizes of sand are precipitated. Because of the large amount of dirt in the aggregate about 450 gal. of washing water are used for each cubic yard of aggregate. About 1.6 yd. of material are handled for each yard of finished aggregate. The five sizes of aggregates drop into separate bins beneath the processing plant from which they are removed by belt conveyor to storage piles located over a tunnel in which is installed another belt conveyor that transports them to bins on top of the tramway terminal.

The 10,000-ft. tramway, whose

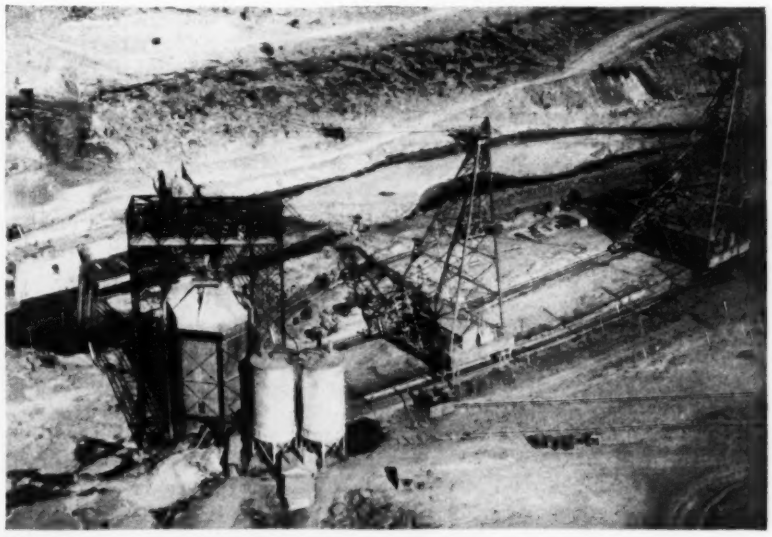

Fig. 1. Concreting plant at Conchas Dam. Framework over the aggregate bins is end tower of aggregate tramway. Mixers are housed below bins.

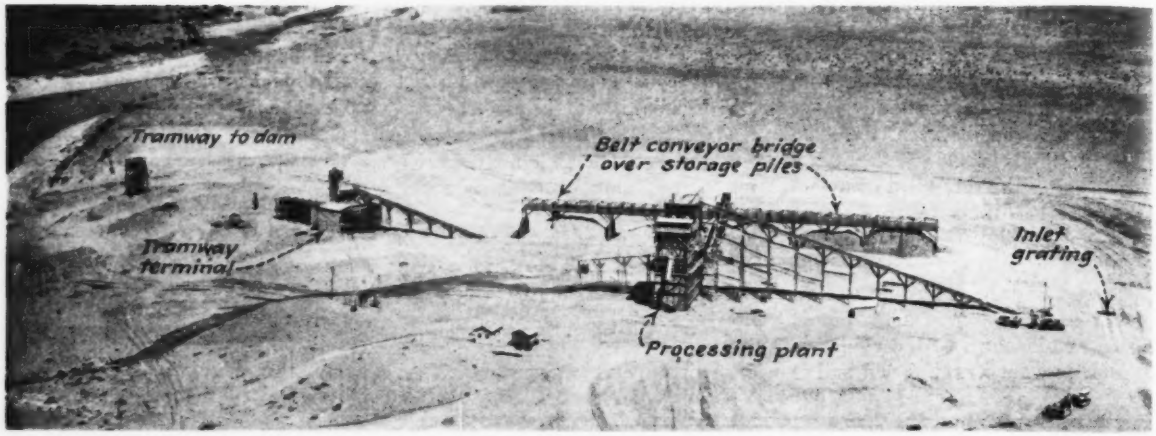

Fig. 2. Plant where gravel is separated into three aggregate and two sand sizes and where principal storage is maintained is connected with dam by a 2-mile tramway.

continuous cable encircles this terminal building, is equipped with eighty-four 36-cu.ft. buckets and has a nominal capacity of 224 tons an hour although, running at a speed of 560 ft. per min., it has been able to transport 240 tons an hour, an increase made possible by the use of 63-cycle instead of 60-cycle current. As the buckets come into the terminal building they are automatically disengaged from the cable and coast onto a circular track surrounding the hoppers below the storage bins. After each bucket is loaded, it coasts (the track being on a slight downgrade) around to the opposite side of the terminal. Here a timing device trips a lever that engages the bucket to the cable, and it is off on its two-mile trip to the mixing plant.

At the mixing plant the buckets dump into the overhead compartment bins without slackening speed. These bins, triangular in plan, occupy the top story of an hexagonal-shaped structure on the second story of which the two 4-yd. mixers are installed. The bin bottoms slope toward a batcher at the center which can be dumped into either mixer. The most modern weighing and recording apparatus is used, and the entire plant is electrically operated.

Cement is stored in two adjacent cement silos, each of 5,000-barrel capacity, pumps moving it from the silos to a 1000-bbl. tank above the mixers. Such large capacity is required because cement must be trucked 24 miles from the railroad, and a bad storm or truck breakdown might interrupt the supply.

The first or ground floor of the mixing plant building is the concrete loading dock. The 4-cu.yd. concrete buckets mounted on rail cars are moved onto this floor by a gasoline locomotive, filled from the mixers and then pulled out under the cableway. This cableway, with two 145-ft. head-towers and a 183-ft. tail-tower, has a span of 1650 ft. Each head tower is driven by two electric motors, located at opposite corners, a type of direct drive that is said to be completely new and unusually efficient. The track upon which the towers operate is set on a concrete base for extreme accuracy. Functioning of all of this construction plant has been entirely up to expectations, and the contractor, Bent Brothers, Inc., and Griffith Co., Los Angeles, considers it the best he has installed on any of the 23 dam jobs he has built before. About 60 per cent of the dam concrete has been placed.

Cities Save Money By Using Callable Bonds

THE many American cities now planning their annual budgets or drafting long-term financial programs will look with special interest upon the report of the committee on municipal debt administration of the Municipal Finance Officers' Association, which finds that scores of municipalities and counties during the period 1933–37 made phenomenal interest savings by using their callable bond privilege.

The report entitled "The Call Feature in Municipal Bonds," has just been published by the association which has offices at 850 East 58th St., Chicago. The committee making it is composed of seven city officials, one bond man and one statistician, and the report is a thorough study of what use cities may make of callable bonds.

The report observes that time will tell how many other municipalities will take a leaf from the book of big business and install the callable bond in their financial policies. This type of bond is fairly common in private corporate financing. Among cities using the callable bond to a limited extent in one form or another are: New York, Chicago, Los Angeles, Cincinnati, Fort Worth, Detroit, Erie (Pa.), Tallahassee and Dearborn. These cities during depression years were able to make savings by callable bond operations, because at early dates they had reserved in their 4, 5 and 6 per cent bonds the right subsequently to call them and pay off bondholders in cash. The cash was secured by selling new refunding bonds; and the great reduction in their interest burdens was because bonds could be sold in a 2 to 3 per cent market.

The report points out that the current municipal bond market is not a good time to issue callables because interest rates are low. It predicts that when another boom period is well underway the call feature will probably be more commonly inserted in municipal bonds. Possible savings from use of the optional privilege are now rather vivid in the minds of public officials. A wider usage in the future promises to be one of the more permanent effects of the depression upon municipal finance.

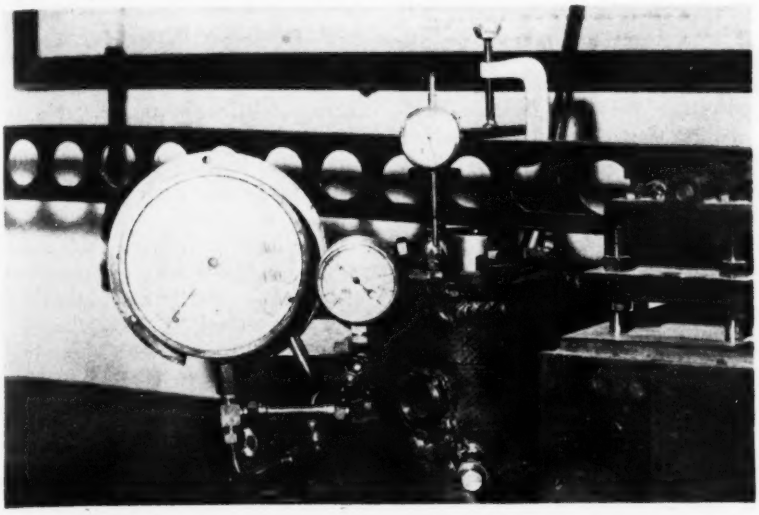

FIG. 1. STABILOMETER FOR DETERMINING PROPERTIES OF SOIL SAMPLES

A Soil Survey by Stabilometer

E. C. SEIBERT AND L. A. PALMER

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Soil characteristics measured in terms of pressure on drydock and cofferdam walls by stabilometer and direct-shear test apparatus

A METHOD of construction for a proposed drydock contemplated surrounding the site with a cofferdam by driving steel sheetpiles into tule mud and clay to form cylindrical cells, and then replacing the material in the cells with material of greater stability. Subsequently it was proposed to remove the material enclosed by this cofferdam to permit construction of the dock in the dry. Designing for this construction procedure thus involved evaluating the horizontal earth pressure of the consolidated fill at rest behind the unyielding massive dry dock walls, the active horizontal earth pressure of the fill within the yielding cofferdam cells, and the passive horizontal earth pressure and shearing resistance of that fill material resisting the thrust of the earth tending to push the cofferdam cells in toward the dock. Borings at the dock site uncovered a cohesive, plastic material quite unlike the granular soils assumed in analyses by the usual theories of earth pressures, and thus necessitated an experimental determination of angle of internal friction, cohesive force, and horizontal pressure at rest for the materials actually encountered at the site.

Consequently, a stabilometer (Fig. 1) was used to measure the horizontal earth pressure corresponding to various vertical pressures applied to samples of the soil as taken from the dock site. Testing soil samples in a direct shear apparatus yielded values of the angle of internal friction, cohesive force, and shear resistance. These two pieces of testing equipment furnished all the experimental data required for design purposes as they gave the designer sufficient information for preparing diagrams of the horizontal earth pressure variation with depth of soil for the drydock's retaining structures.

In using a stabilometer (Figs. 1 and 2), the jacket is filled with water, the rubber hollow-cylinder and bottom anvil are lowered into the water within the apparatus, and the lugs holding a conical retaining ring at the top of the rubber cylinder are tightened down. The rubber cylinder is next expanded into a barrel shape when a vacuum is created by removing part of the water from the jacket. This barrel shape of the rubber cylinder facilitates the placing of the previously-prepared earth sample inside the cylinder. With the sample in place the body of the stabilometer is completely filled with water, and a piston is placed within the conical retaining ring and on top of the earth sample. The stabilometer is then ready for a soil sample test.

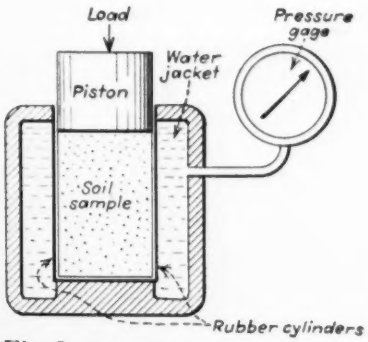

Fig. 2. Horizontal earth pressure caused by applying a vertical load to the stabilometer piston is transmitted through a rubber cylinder to the surrounding water and is recorded on the gage.

A very satisfactory device for cutting the earth samples to the cylindrical form required by the stabilometer test has been constructed at the Bureau of Public Roads laboratory. It consists essentially of a top and a bottom pivoted disk, with friction or holding lugs (on one surface of each disk), between which the earth sample is held. The disks, with the earth sample, are rotated, and vertical cuts are made along the elements of the cylinder with a piano wire carried in a hack-saw frame. By turning the sample through successive small arcs and cutting along elemental lines of the cylinder, a very excellent sample is prepared. The top and bottom of the cylindrical sample are cut off square by the same piano wire in the saw-frame; a piece of pipe of internal diameter slightly greater than the diameter of the sample being slipped over the sample as a guide for the saw.

Soil samples of sand or other loose material are simply poured into the

* The opinions or assertions contained in this paper are the private ones of the writers, and are not to be construed as official or reflecting the views of the Navy Department or the Naval service at large, nor of the Bureau of Public Roads.

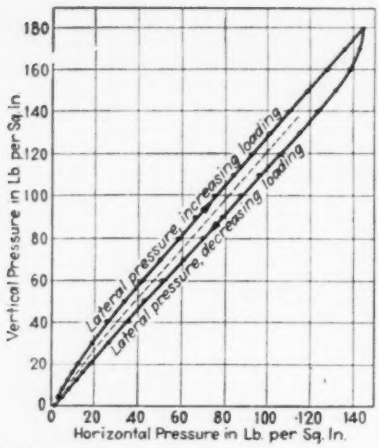
Vertical Pressure in Lb. per Sq. In.
Horizontal Pressure in Lb. per Sq. In.
Lateral pressure, increasing loading
Lateral pressure, decreasing loading

Fig. 3. **Horizontal earth pressures read from stabilometer gage often show divergence due to method of varying vertical pressure.**

rubber cylindrical casing in the body of the stabilometer.

In testing a soil sample with the stabilometer, vertical loads are applied in increments to the piston by means of a weighted lever system. The vertical load causes the soil to exert a horizontal pressure on the rubber cylinder which transmits the pressure to the water surrounding it. A pressure gage connected to the water jacket measures the horizontal pressure.

The stabilometer's basic purpose is to evaluate the ratio of the horizontal pressure in a soil to the vertical pressure of its weight or surcharge. Since the ratio varies for different soils depending on moisture content and degree of consolidation, the stabilometer performs the important function of providing information for evaluating the pressure exerted by a particular soil. Undisturbed samples show a different value for this ratio than reworked samples, so it is important that the ratio be determined for a soil in its "in place" condition.

Typical horizontal earth pressure curves (Fig. 3) show considerable divergence depending on whether the vertical load is being increased or decreased, but almost coincident curves can be obtained by allowing sufficient time to establish equilibrium after each load application. On the other hand, reasonably rapid tests are to be preferred for a certain amount of water is squeezed out of the earth sample during the test.

If it is assumed that the soil in place in the area under study has been completely consolidated due to its own buoyed weight and is so completely saturated that full active hydrostatic uplift exists, then the total horizontal pressure exerted by the submerged soil is equal to ordinary hydrostatic pressure plus the horizontal pressure of soil particles whose weight is reduced by buoyancy. Thus, it is evident that full hydrostatic pressure must be added to the stabilometer gage reading to get the total horizontal pressure since a

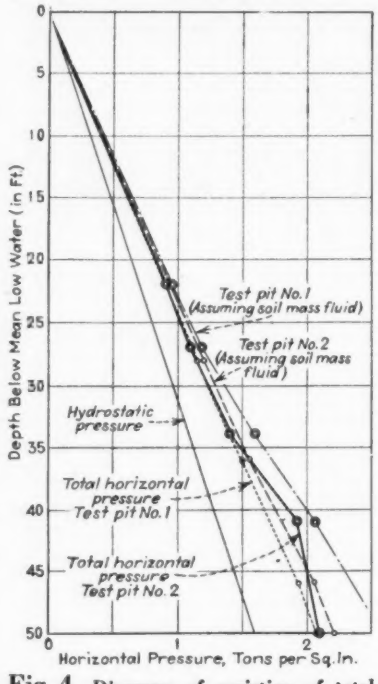
Depth Below Mean Low Water (in Ft.)
Horizontal Pressure, Tons per Sq. In.
Test pit No. 1 (Assuming soil mass fluid)
Test pit No. 2 (Assuming soil mass fluid)
Hydrostatic pressure
Total horizontal pressure Test pit No. 1
Total horizontal pressure Test pit No. 2

Fig. 4. **Diagrams of variation of total horizontal earth pressure with depth in two test pits indicate that tule mud acts like a fluid.**

vertical load applied to the soil sample represents only the effective weight of the soil particles.

Total horizontal pressures, computed at each of several depths in two test pits at the dock site by adding full hydrostatic pressure to the stabilometer gage readings of the soil samples, show a close agreement between the two test pits (Fig. 4). Three additional curves in Fig. 4 compare the magnitude of the total horizontal pressure with hydrostatic pressure and the total horizontal pressure which would exist if the soil were a fluid (horizontal soil pressure = vertical soil pressure).

The usual direct shearing apparatus, in which a soil sample is placed inside a block and then sheared along a plane by applying a pull to the upper movable portion of the block while simultaneously applying a normal force to the sample, was used to measure the soil sample's shear resistance. Resistance to failure by shearing, s, is composed of two parts: (1) cohesion, c, and (2) internal friction, $n \tan \phi$. This is expressed mathematically as

$$s = n \tan \phi + c$$

where ϕ is the angle of internal friction.

In testing with the direct shear apparatus, a normal pressure n is applied to the specimen, and then the force s required to shear the soil sample is observed. With these two values, the angle of internal friction and the cohesive force can be obtained by plotting s versus n.

The stabilometer may be used in connection with the investigation of the behavior of soils, not only in its form as hereinbefore described, but with certain additions allowing expansion of the soil sample under constant horizontal or vertical pressure, and considerable data have been obtained in a series of tests conducted jointly by the Bureau of Yards and Docks and the Bureau of Public Roads.

In some of these basic tests the unknown element of consolidation pressure of natural "undisturbed" samples was eliminated by the artificial consolidation of earths, which were completely encased with a surrounding layer of porous sand, in a watertight thin rubber container and subjected, over a period of weeks, to a known pressure, applied hydrostatically in a suitable pressure container. Through the wall of the container a tube carrying a "feed" of water was connected to the sand layer surrounding the earth.

Test samples for the stabilometer were taken from such artificially consolidated specimens.

The tests outlined above were conducted at the Bureau of Public Roads subgrade laboratory at Arlington, Va., with C. H. Bramhall, assistant mechanical engineer of the Bureau of Yards and Docks, giving valuable assistance in the design, construction, and operation.

The basic principle of the stabilometer as used in these tests is much the same as that described by Thos. E. Stanton, Jr., and F. N. Hveem in Part II, *Proceedings* of the 14th Annual Meeting of the Highway Research Board, December 1934; by Prof. Wm. S. Housel in the 1936 *Proceedings* of the A.S.T.M., and possibly by other investigators.

Green Bay Ends Sewage Pollution

JERRY DONOHUE
President, Jerry Donohue Engineering Co., Sheboygan, Wis.

Construction of intercepting sewers and a disposal plant employing sedimentation and separate sludge digestion advances the Fox River cleanup program

AN IMPORTANT FACTOR in the comprehensive pollution abatement plan for the Fox River in Wisconsin, was to provide for the collection and treatment of the sewage from the city of Green Bay. To carry out this program a Metropolitan Sewerage District was formed which undertook the construction of 14 mi. of intercepters, 25 stormwater control stations, a stormwater pumping station and a disposal plant of the separate sludge-digestion type. Work was started in 1933 and completed in the fall of 1937.

Green Bay led the way and was the first city in the lower valley of the Fox River to take steps toward the installation of pollution remedial measures. Previous to the construction of intercepters all city sewers ran directly into the Fox River or into the nearby East River. The latter stream, having a relatively small drainage area with no artificial storage, practically goes dry during the summer months, and since it received 45 per cent of the city's sewage it was in effect an open cesspool.

Because of the low elevation of the greater part of the city, practically all of the sewer outlets were submerged during ordinary lake level stages, thereby creating septic conditions which in many cases resulted in serious disintegration of the upper part of the sewers.

River conditions intolerable

During the past decade such intense odors emanated from the East River, and at certain times of the year from the Fox River, that people could not sleep at night without keeping the windows of their homes closed. It was conceded, therefore, that the lower East River needed first attention. Unlike the Fox, this river presented a situation which was local in character and being a smaller stream, it was more badly polluted. It was also pointed out that the cleanup of the East River would aid conditions in the Fox River because the latter received its flow.

In 1930 the city employed the writer's firm and they in turn called in consultation Alvord, Burdick and Howson to make a thorough study of the entire problem. The engineers recommended that the city sponsor the creation of a metropolitan sewerage district, take in the surrounding developed territory and construct intercepting sewers to remove all pollution from the East River. By dividing the large project into two subdivisions (the East River and the Fox River districts) several advantages were secured: (1) the construction of the intercepters in the East River district where the most acute condition existed, gave early relief by removal of that pollution, and (2) the operation of the treatment plant during the time between the completion of the work in the East River district and the commencement of work in the Fox River district gave the engineers an opportunity to study operating conditions, and enabled

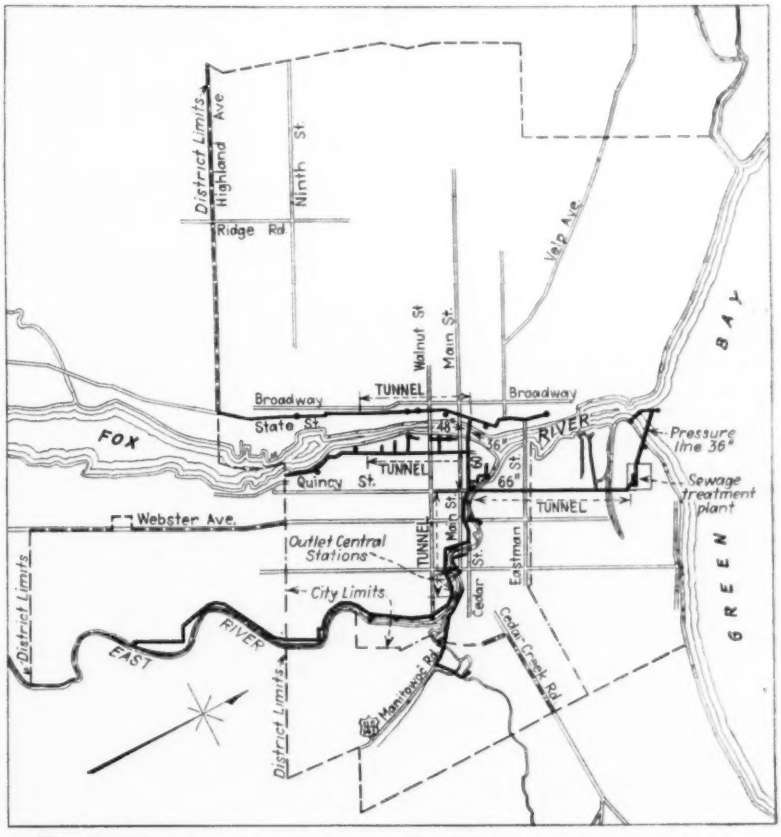

Fig. 1. Principal features of the Green Bay Metropolitan Sewerage District.

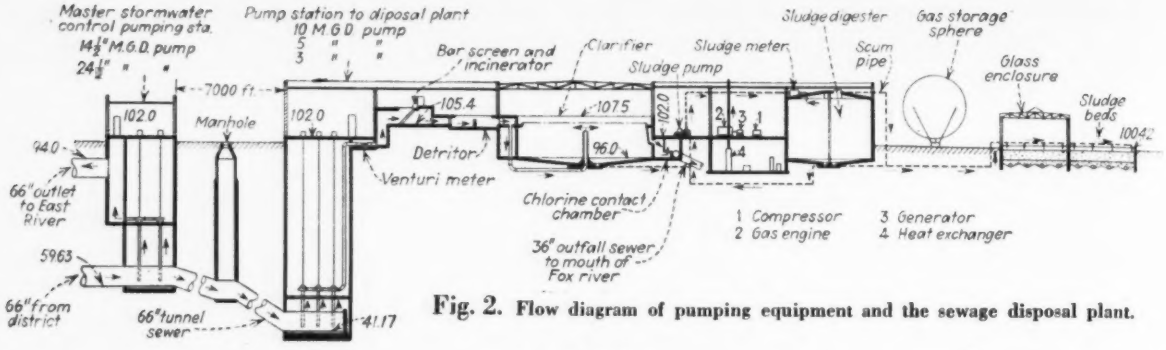

Fig. 2. Flow diagram of pumping equipment and the sewage disposal plant.

them to get valuable data which affected the final design.

Following a favorable state Supreme Court decision as to the validity of the district's financial ability (it was the first district organized under a new Wisconsin law) a PWA loan and 30 per cent grant was obtained and in 1933 a contract for borings and test holes along the line of the proposed intercepter was let. A second loan and 45 per cent grant was obtained in 1935 for the Green Bay district intercepters and for doubling the capacity of the treatment plant.

In the plans adopted for the enlargement of the sewage treatment plant, the experience of building and operating the first unit was a decided factor in making several important improvements in the final plan including the 39-m.g.d. master stormwater pumping station, and utilization of sludge gas for power.

Tunnels and river crossings

Of the 14 mi. of intercepters, 4.65 mi. of sewers are constructed in tunnels. The main tunnel sewers in the intercepting system were built in a clay stratum which underlies the entire area. This stratum was carefully located by borings taken before any contracts were called for and the information thus made available to the bidders saved the district thousands of dollars.

A double-pipe river crossing consisting of a 36-in. and an 18-in. cast-iron pipe was constructed in a dredged trench 40 ft. below the surface of the Fox River. In addition one-half mile of 36-in. reinforced concrete pressure pipe was laid to carry the effluent from the plant out into the Fox River near its mouth.

The treatment plant, located near the bay shore, receives sewage through a 66-in. tunnel, the lower

Fig. 3. Flexible joint cast iron pipe used on the river crossing. The smaller pipe (18 in.) accommodates the normal sewage flow and the 36 in. line carries stormwater flows

500 ft. of which serves as a wet well for the three sewage pumps. The pumping plant includes a 10-, a 5- and a 3-m.g.d.

The function of the stormwater control stations which are located on the main sewers near their outlets is to divert the excessive storm flows directly to the river while the sanitary flow continues on to the treatment plant.

The design of the stations and the intercepters allows for the collection of 500 gal. per capita per day without spilling any sewage into the storm overflow. The control stations constructed under the first (East River) project are concrete chambers through which the entire flow of the outlet sewers passes. The normal flow is diverted to the intercepter through an orifice, which restricts the flow to the design capacity of the sewer. When the storm flow comes on, a float, riding in a 12-in. tube, actuates an electric motor which opens the stormwater gate, permitting the excess flow to go directly to the river.

For the Fox River project it was decided to use a self-operating type of stormwater control station, one which would not be as costly to build or as expensive to operate and maintain. The type of control station adopted was one developed by the Milwaukee Sewerage Commission, and their engineers are to be credited with a commendable contribution to the solution of the problem of controlling the volume of stormwater entering an intercepting system from a combined system of sewers.

A reinforced concrete chamber is constructed around the sewer to be intercepted at or near its outlet. On the downstream end of this chamber a dam, made up of removable planks recessed into a channel slot, shuts off the sewer from its old outlet. The height of the dam is adjusted to allow excessive flows to go over the top to the old outlet. The dam also serves to prevent water from the river backing into the intercepter. The intercepter connection to the chamber is made through a rectangular channel into which a hinged gate is secured in such a manner as to control the volume discharged through the intercepter connection.

When the storm flow comes on,

the water in the main chamber rises above the horizontal shaft, thus holding the gate in position. This shaft is secured to the gate about one-third up from the bottom. Water pressure above this line moves the bottom of the gate down toward the floor, thus decreasing the cross-sectional area of the opening, the theory being that with an increased head the discharge area should be reduced in order to control the volume intercepted. These control stations are entirely below ground; access is gained through manholes.

The combined sewers at Green Bay carry a large amount of rain water during certain periods of the year. The heaviest flows occur during the period of melting snows in the months of February and March, and occasionally during the summer months. All of this water entering the system must be pumped at the

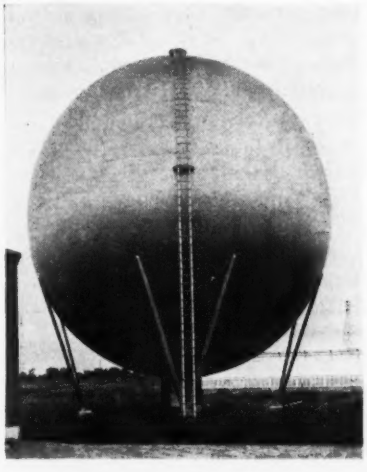

Fig. 4. Gasholder with a capacity of 178,000 cu.ft. at 40 lb. pressure for storing sludge gas

treatment plant against a head of 50 ft. The cost of pumping excessive flows against this head prompted the engineers to insert a master-control stormwater-pumping station in the main-tunnel outlet between the treatment plant and the city.

The stormwater station is placed directly over the tunnel leading to the plant, so that when excessive flows occur and the tunnels become filled the control station goes into operation; the excessive rain water is thus pumped directly into the East River before it reaches the treatment plant. This not only relieves the sewage treatment plant of the excessive flow, but the large volume of water is handled against a much smaller head, thus saving in pumping costs.

Sewage reaches the treatment plant through the 66-in. outlet tunnel, which terminates in a pump pit 55 ft. below ground. By means of electrical control devices the three pumping units are automatically operated, but the operators make periodic inspections to see that all parts are working properly. The pumps discharge directly into a pipe header which conducts incoming sewage to a mechanically-cleaned bar screen with 2 in. openings. The screenings are destroyed in an incinerator.

From the screen chamber the sewage passes through a detriter where the sand and grit is washed free of organic matter and removed for fill in the area around the plant. From the grit chamber the sewage enters four clarifiers which operate in parallel. The sewage is delivered to these tanks through an under-feed pipe which permits a circumferential flow to the effluent channel. Sludge is pumped to one of four digestion tanks which are piped for single-stage digestion or multiple-digestion. Grease and oil rising to the surface of the clarifiers are mechanically skimmed and disposed of in the incinerator. The effluent from the clarifier is chlorinated before being discharged through a submerged outlet 10 ft. below surface, at the mouth of the Fox River.

PROJECT HIGHLIGHTS

Capacity:	9 m.g.d. present 12 m.g.d. future
Treatment:	Sedimentation, chlorination, sludge digestion, and air drying of sludge
Purification:	Suspended solids removal, 60 per cent
Power Production:	Sludge gas used as fuel to operate two gas engines, 90 and 120 hp., driving one 80-kva. and one 105-kva. generator
Cost:	Intercepting sewer system (14 mi.) $1,092,000 Treatment works 484,600 Stormwater control and pumping station .... 42,000 Total .$1,618,600

The gas collected from the digesters is connected through a piping system to two internal combustion engines. One of these, a 3-cylinder, 90-hp. 514-r.p.m. machine, is directly connected to an 80-kva. 60-kw. induction generator, 3-phase, 60-cycle, 4,000-volt; the other engine is a 4-cylinder 120-hp. machine connected to a 105-kva. generator. The engines are mounted on foundations separated from the powerhouse floor, and the joint between floor and foundation is filled with shock absorbing material. The generators are connected with the incoming power

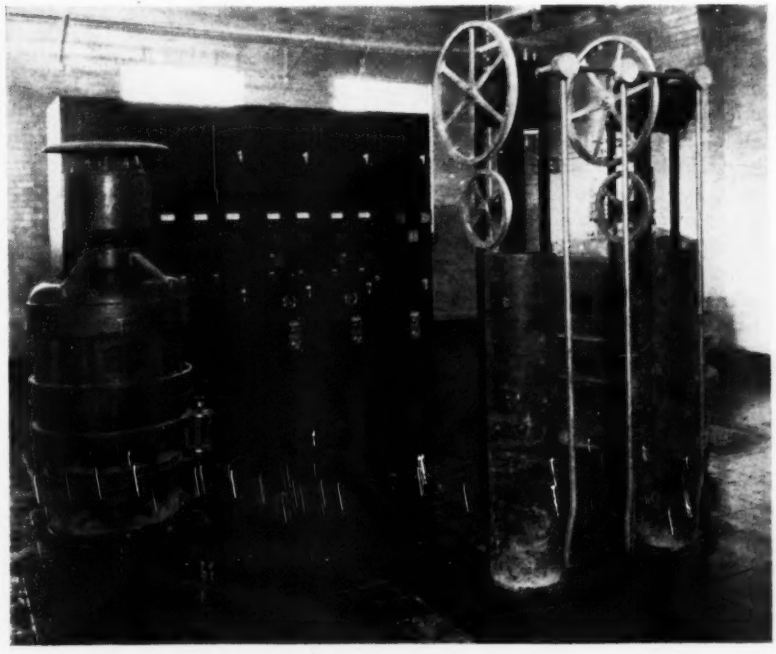

Fig. 5. Multi-point float switches and control panel for automatic starting and stopping of stormwater pumping units

line which supplies current for operation. Since the engines have been placed in operation very little outside energy is needed, and at times an oversupply is produced which is sent back into the line.

The engine equipment was purchased on a production guarantee basis. The manufacturer agreed to develop 1 kw-hr. from 14,850 B.t.u. at full load, 16,100 B.t.u. at three-quarters load and 19,150 B.t.u. at one-half load. The average consumption of gas during 3 months operation has been 25.7 cu.ft. per kw-hr. generated.

Operation of the gas engines has solved the problem of high pumping costs. Before their installation the pumping charges per million gallons averaged $6.64 based on an average cost of power of 2.42 c. per kw-hr.; about 40 per cent of the power cost can be attributed to the demand charge. Since the engines have been placed in operation the amount of power purchased has diminished to 2,000 kw-hr. per month, the generators have produced more power than the entire plant has used, and the cost per million gallons for purchased power dropped from $6.64 to $1.89. On this basis the investment of $16,500 in power house and equipment, making suitable allowance for depreciation and operating cost, will be eliminated in less than 5 years.

The generators are now producing power having a daily value of $40 based on the average cost of power over the 3-year period. A gasholder with storage capacity of 178,000 cu.ft. at 40 lb. pressure has been helpful in working out engine operating schedules to minimize the peak loads and excessive demand costs. This storage is sufficient for 8 days' operation.

The total cost of the sewerage system was $1,618,600, made up of $1,092,000 for 14 mi. of 8 to 66-in. intercepters and 25 control stations, $42,000 for the master control station, $363,200 for the general sewage treatment plant contract, $21,000 for gasholder and $100,400 for machinery and equipment.

The engineers enjoyed the confidence of the three commissioners of the district, and the writer acknowledges the help and cooperation of Commissioners James McGinnis, Joseph Servotte and T. H. Silverwood; I. G. Alk, attorney, and George Martin, plant superintendent.

Surface Water Supply Recommended For Houston

Existing supply from wells called grossly inadequate and 10-year program of rehabilitation with new surface supply from San Jacinto River is recommended

AFTER CHARACTERIZING the water system of Houston, Tex., as deficient on practically every count Alvord, Burdick & Howson, consulting engineers, Chicago, in a report to the mayor and city commissioners have recommended that the water department be placed in the hands of an appointed water board made up of qualified men, that a surface supply from the San Jacinto River be sought rather than expand the present well system, and that revenues be augmented by sale of water to industries which now supply their own water.

The first objective has been accomplished by the selection of the personnel of a citizens advisory committee of business men to act as a temporary water board until such time as enabling legislation can be passed to legalize this type of management.

A surface supply was recommended over wells because the cost per million gallons delivered decreases with increased use whereas with wells the cost increases or at best remains constant. (Wells have an average life of only 12 yr.). A second advantage is that surface supply developments will be permanently useful whereas with wells there is a growing danger of salt encroachment and abandonment.

The San Jacinto as a source was recommended over the Brazos the Trinity and the Colorado rivers since that water is soft without treatment, relatively free from silt and free from prior appropriations or developments for flood control or artificial storage for other purposes. The San Jacinto is relatively small and the minimum low-water flow is such that storage would be necessary, but several favorable storage sites are available. This source can be supplemented by pumpage from the Trinity at some future date if necessary. Filtration is essential for all surface supplies investigated and would produce a water equal if not superior to the best well water.

The San Jacinto supply brought in by pipeline would cost $12,513,000; using a 10½ mi. canal the cost would be $10,600,000. Water from the latter will cost per 1,000 gal., 6.8c. and 4.1c. in 1940 and 1950 respectively.

All projects were estimated and compared on the basis of a development to meet 1950 requirements; population 650,000 (it is now 400,000); average daily pumpage, 72 m.g.d.; maximum 24-hr. pumpage, 125 m.g.d. Estimates of the various projects were as follows:

Project	Construction Cost	Cost per 1,000 gal. in cents 1940	1950
Well supply	$8,869,000	7.8	4.0
Colorado River	19,972,000	12.0	7.1
Brazos River by pipeline	11,687,000	8.3	5.7
Brazos River by canal	9,233,000	7.2	5.0
San Jacinto by pipeline	12,513,000	7.8	4.7
San Jacinto by canal	10,600,000	6.8	4.1
Wells for city, San Jacinto water for industry	11,403,000	8.4	5.1

Existing system

Pumpage at present is 25 m.g.d. for domestic use only. This is less than one-third of the total water used in Houston. The water comes from nineteen wells through seven pumping stations scattered over the city. The per capita consumption of 72 g.p.d. it is estimated will reach 145 g.p.d. in 1980 giving 34 m.g.d. in 1940 72 m.g.d. in 1950 and 175 m.g.d. in 1970. Costs today at 4.6c. per 1,000 gal. The quantity is deficient for good service and fire protection. Lack of the latter requirement costs the citizens $180,000 annually in extra charges for insurance premiums. The industrial pumpage in the Ship Channel area east of Houston is 41 m.g.d. The combined

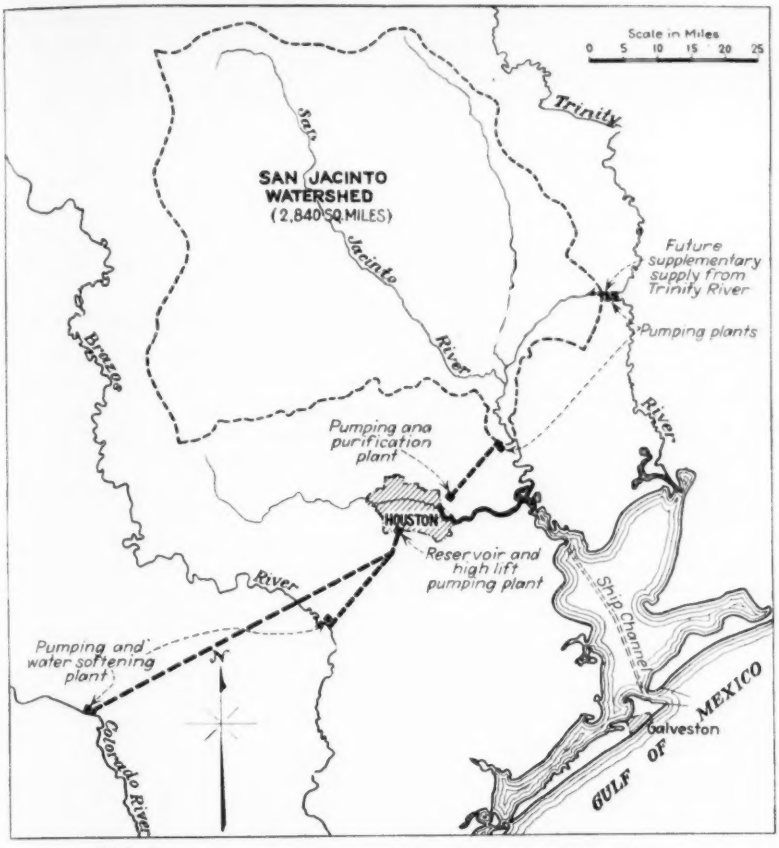

Fig. 1. Surface water supply projects investigated for Houston

industrial and municipal pumpage is 200 g.p.d. per capita of which the industrial load is 70 per cent. The maximum capacity of the existing municipal system is 100 g.p.d. per capita, about one-third to one-half of the maximum days use of comparable cities.

Other deficiencies noted in the report are as follows: Houston has in its distribution system over 321 mi. of pipe 6 in. and smaller (it should be 250 mi.). About 60 per cent of all mileage is 2 in. or less in diameter. The 1.4 mi. of 24-in. and larger pipe compares with 20 to 40 mi. usually found in an average city. Hydrant spacing frequently exceeds 1,500 ft. and should not exceed 500 to 600 ft. Floods have submerged the principal pumping station twice in the last 10 years. Annual revenues are $3.50 per capita compared with the $6 average, thus limiting development. The average city of 400,000 people has a $20,000,000 investment in waterworks. Houston has $6,800,000, indicating a lag of at least $10,000,000.

Included in the estimate of betterments recommended to correct deficiencies are the following items: Large mains within the central mercantile district fire limits; 1,400 new hydrants; cast-iron mains to replace the 2-in. and smaller wrought-iron "mains"; and secondary feeders. The total cost would be $6,500,000, spread over a 10-yr. period.

The initial San Jacinto development would consist of a low weir-type dam to impound 9,000 m.g., a pumping station on the San Jacinto River north of Sheldon and a canal to a 100-m.g.d. purification plant and high-lift station at Market St., 2 mi. west of Hunting Bayou, thence arterial mains would discharge into the present distribution system. A stand-by pumping plant at the present 15-m.g.d. Sabine St. reservoir would supersede Central Plant pumping station to provide for fire protection in the downtown districts and part of the maximum day pumpage peak. Three elevated tanks near the western city limits would serve to maintain good pressures at times of heavy draft in those areas remote from the source of supply.

If the city could obtain contracts from industries as Birmingham, Ala. did, the full project adequate to 1950 could be financed but otherwise the report recommends a modified program with partial dependence on the existing well supply until such time as sales are built up. This reduced plan would eliminate some pumps, cut in half the purification plant to 50 m.g.d., defer one-quarter of the feeder mains and three elevated tanks. The total reduced program would then be $7,121,000 made up as follows: Dam, $2,319,000; pump station at Sheldon, $175,000; canal, $266,000; city pumping station, $400,000; purification plant, $1,014,000; filtered water storage $175,000; feeder mains $2,535,000 and Sabine booster station, $237,000.

The task of building up the system is a large undertaking, a continuing task of increasing magnitude. Deficiencies of many years are involved. For every 100,000 increase in population from $4,000,000 to $5,000,000 will have to be spent on the waterworks. The handicaps to a growing city are "almost painfully evident." These arguments along with the need to get 100 cents worth for every dollar spent led the engineers to recommend the divorce of the waterworks from politics and the establishment of an appointive board of qualified men.

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Aerial Camera Survey To Be Made in Alaska

AERIAL MAPS of a 10,000-sq.mi. region east of Fairbanks, Alaska, will be made from photographs to be taken under the direction of the U. S. Geological Survey this summer. This is part of the area through which the proposed Alaska highway probably will be routed, if present American-Canadian ambitions for such a transportation connection materialize, and over which the new Juneau-Fairbanks air route now passes. In addition to their use in reconnaisance for highways, these topographic maps are designed to be of use to settlers in the area, an aid to forest protection in the public lands and to continued mining development in that region.

Gerald FitzGerald, topographer of the Geological Survey, will direct the work and John M. Haynie, senior photogrammetrist aide of the hydrographic office of the Navy Department, whose services have been made available to the Geological Survey, will make the air-view pictures.

Flood Gates Protect Manufacturing Plant

J. E. WEBSTER

General Works Engineer, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

Backwater from the Monongahela River kept from flooding Westinghouse plant at East Pittsburgh by flood gates and pumping plant in Turtle Creek

THE PARENT, or East Pittsburgh, plant of the Westinghouse Electric & Manufacturing Co. is situated on Turtle Creek one and one-half miles from where the creek empties into the Monongahela River. Main floor levels of the plant are from El. 738.5 to 742 and are subjected to flooding by slackwater from the Monongahela River, which reached El. 746 in 1936. The plant has occupied its present site since 1894 and has experienced four floods; in 1907 when the water level reached El. 743.5, two floods in 1924 with water levels at El. 742 and 741.6 and the record-breaking 1936 flood when the level at the plant was 746 ft.

All who know the extent of the plant, its investment in equipment, and the large stocks of raw and finished stocks can appreciate the havoc which these floods have caused. The total cost of floods to the Westinghouse is of the order of four to five millions over a period of forty years and the same floods now would cause much more damage as the investment is larger. The flood risk is at least $150,000 per year.

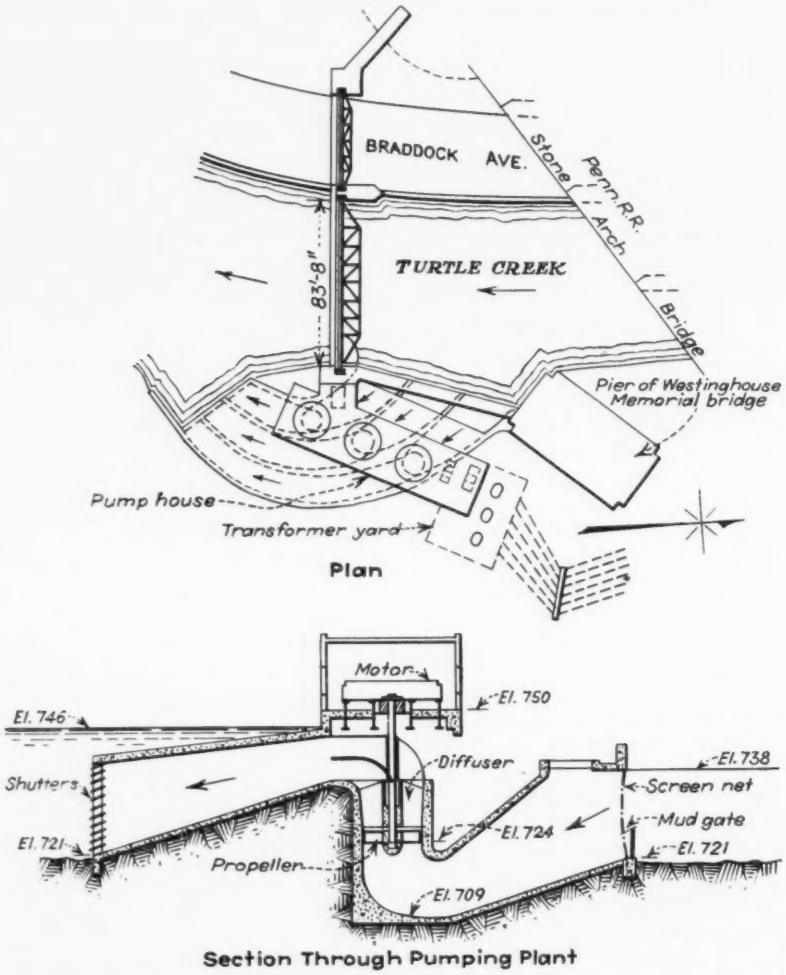

Fig. 1. Flood gates to protect the Westinghouse plant from backwater in Turtle Creek span both the creek and Braddock Ave. and with the pump house form a dam across the low area of the valley.

At the time of the 1907 flood the Westinghouse Machine Works, now the South Philadelphia Plant, occupied the floor levels below El. 740. After that flood about 600,000 sq. ft. of the floors of the company which were at the 740-ft. level were equipped with flood gates and pumps to take care of water up to El. 744. It was 29 years before the gates were used and then for only a few hours as the 1936 flood went bravely over the top.

After the 1936 flood, protective measures were again studied and it soon became evident that it was impractical to depend on flood gates at the windows as they are but four feet above floor level and much of of the floor area is on cinder fill subject to heavy seepage.

The plan adopted was first suggested after the 1907 flood, but the needed pumping equipment had not then been developed and protection to El. 746 did not seem to be needed.

The present plan was made practical by the fact that the main line of the Pennsylvania R.R. with track at El. 754 crosses Turtle Creek just South of the Westinghouse plant on a three-span stone arch bridge. Braddock Ave. with road elevation of 729.5 ft. passes under one arch and the creek with a bed of 722 ft. goes under the other two, although the creek uses all three at heavy flow. Gates across the creek and avenue just below the railroad bridge thus would keep flood water from the

Monongahela from backing up the valley making the problem that of pumping the creek water out into the higher water below the gates.

The plan was sufficiently promising to authorize a preliminary study and estimate and to determine whether clearances could be obtained. As Westinghouse engineers had handled no projects of this sort, Prof. H. A. Thomas, in charge of the hydraulic department of the Carnegie Institute of Technology, was engaged as a consultant. His advice was valuable in supplying standards of pier and gate designs and in working out the capacities and setting of the pumps.

The records of the State Department of Forests and Waters show that the maximum recorded runoff in Turtle Creek is just under 10,000 sec.-ft. This occurred in September, 1911, and lasted but a few hours. During the 1936 flood the runoff on the day before the crest in the rivers was about 7,500 sec.-ft., but it decreased to around 4,000 by the time the river rose to a sufficient height to slack the water to East Pittsburgh. Turtle Creek has a drainage area of 146 sq. mi. and it is probable that runoffs greater than 10,000 sec.-ft. will be experienced, but that these high runoffs will occur at the time of high water in the river is very improbable. Water from a general rain or thaw would be out of Turtle Creek at least a day before it reached this district through the rivers.

After much study and discussion the pump requirements were set at 2,500 sec.-ft. for each of three units. One would have been a spare during the 1936 flood. It is not contended that a larger capacity may never be needed, but it is contended that the probability of needing a larger capacity is so slight that the added cost could not be justified.

Westinghouse does not build pumps for the trade but does build pumps to serve Westinghouse condensers and has developed, among other types, principally through the efforts of H. F. Schmidt, consulting engineer, the propellor pump which is the one type fitted for large volumes at low heads. A. I. Ponomareff, hydraulic engineer from our South Philadelphia Plant, came to Pittsburgh and consulted with Prof. Thomas and the writer on various arrangements.

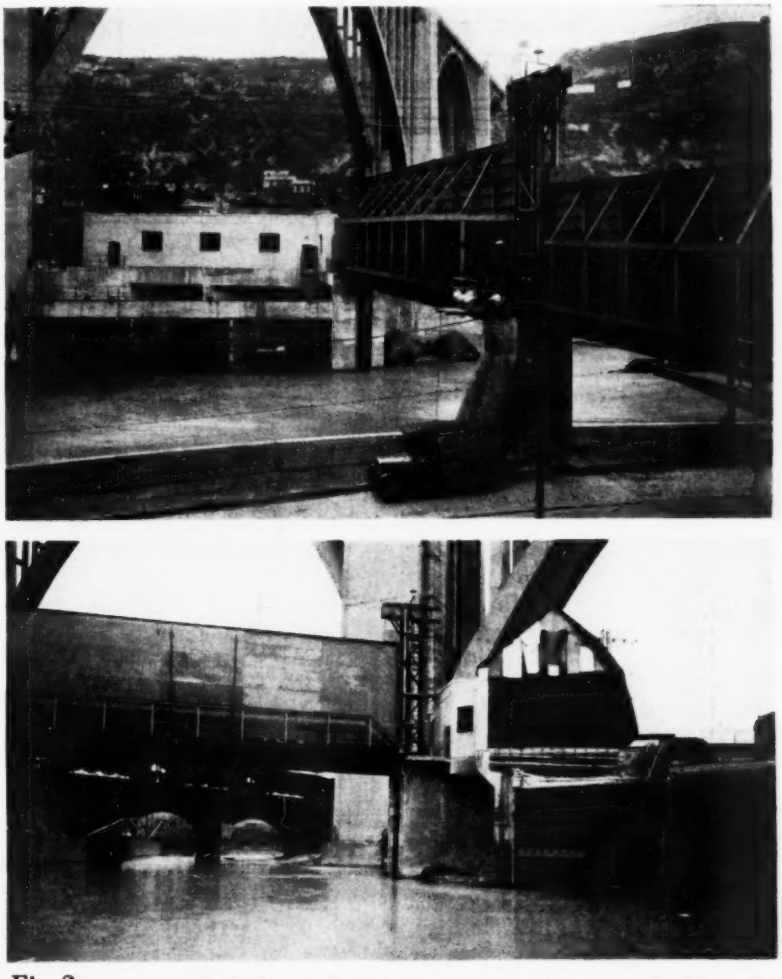

Fig. 2. Turtle Creek flood gates. Intakes for the pump plant are at the left in the upper view. At the right in the lower picture are the shutters which keep water from flowing through the pump chambers when the pumps are not operating.

The gate design was determined by the physical conditions of the site. We made the width of the gate 83 ft. which gives us more section for creek runoff than is obtained by the clearance between the Westinghouse bridge pier and the bluff adjoining Braddock Ave.

The next point to determine was the height of the gates. The 1936 flood has a crest at El. 746, and although greater floods are possible their crests will be affected by Tygart dam and other reservoirs planned in the Allegheny watershed. Under these circumstances it was though that gates to El. 748 would be safe, but the gates as built protect to El. 750.

The question of obtaining a seal under the gate is one that received a great deal of attention; probably more than the problem justified as tests on the completed dam indicate that the scouring action between the gate and the concrete sill as the gate is being closed cleans the sill so thoroughly that no trouble is experienced in lowering the gate down to the sill.

The sill for the creek gate is of concrete carried down to sound rock about 11 ft. below the creek bottom. For clearing the sill of debris horizontal jets on a narrow groove on top of the sill are connected through an 8-in. main to a water main in Braddock Ave. having a static pressure of 90 lb.

A wall under Braddock Ave. with a sill at pavement level also is carried down to rock to prevent scour. Piers for the gate superstructure were made integral with the sills.

Designs for the structures were by Charles E. Ryder, chief engineer, Department of Forests and Water.

Estimates of the construction costs

of the project were made at this stage and an appropriation for its construction was received from the Westinghouse company to construct it with the understanding that it would be ready for the 1938 flood season. This appropriation was approved June 25th, 1937.

It was evident to the writer, who had the responsibility of completing the job, that if the project was to be completed by the middle of February, 1938, it would have to be done by the Westinghouse works maintenance and construction department as no time was available for completion of the plans in sufficient detail to obtain necessary bids from outside concerns. The company also had its own staff of men who did the excavating, concreting and installation, and practically all necessary equipment.

The work was started about July 15, 1937, and the entire project including two pumps, was ready for operation Feb. 15, 1938. The third pump has since been completed.

Many of the details were worked up as the work progressed. These details were those of the gates which were entirely of welded construction. In each gate there are two main horizontal trusses so placed that they will divide the load equally with full head of water on the lower side of the gate and an elevation on the up stream side of 738 ft. or a difference in head of 10 ft. Steel plates were installed on the down stream side of the gates only. The Turtle Creek gate weighs 80 tons, is 83 ft. long and 28 ft. high. The Braddock Ave. gate is 43 ft. long and 20 ft. high.

The method of raising and lowering the gates received a good deal of attention and it was finally decided that sheaves and cable would be used instead of the more elaborate method of construction used by the government for similar structures. One winch driven by a 25-hp. motor is used to raise and lower both gates. There are two drums which can be driven separately by means of a clutch; one controlling the large gate and the other the small gate. The large gate is lifted 28 ft. in about 10 min.

Counterbalanced roller trains are used at each end of the gate to avoid friction as the gates are raised and lowered, the design being similar to that used on some of the government projects. The gates were not counterbalanced as counterbalancing would be very expensive and very little benefit would have been obtained as we wished to be sure the gates would go down as the cables were slacked. The power required for lifting them is insignificant. To be sure that the gates could be lifted in case of power failure a gasoline engine was connected to the winch. Tests have proven that the gates function very smoothly.

Low-head pumps

Details of the pump design were worked out by the engineers of the South Philadelphia plant. A working model was constructed for testing out the construction that would give the best water flow to and from the pumps.

The pump propeller is 11 ft. 10 in. in diameter and the velocity of the water through the pump itself about 21 ft. per second. This velocity is reduced to about 11 ft. at the discharge end of each pump unit.

The intakes have a sill elevation of 721 and are 17 ft. high and 26 ft. wide. They are protected by trash racks which are constructed of 14½-in. horizontal bars at 3-ft. centers and ⅝-in. vertical bars at 9-in. centers. These racks are installed with the rods slack so that at the center they are 18 in. from the plane of their support thus giving them much greater strength than if the rods were taut. Provisions were made for cleaning the racks by installing a suspended bridge across the top of the intakes and about 4 ft. from the face of the racks. It is expected that men on this bridge can keep the trash racks free of rubbish.

Experience has shown that much of the debris that comes down the creek will be washed out before it is necessary to close the gates as the creek runoff from the heavy rainfall that causes the flood will proceed the high water of the main rivers by at least 24 hr.

As most floods will be taken care of with one or two pumps, provision had to be made to prevent water coming back through the idle pumps. This is accomplished by installing gates, similar to those used on exhaust fans, at the delivery end of each pump unit. The discharge end of each unit is 19 ft. high and 12 ft. wide. There are ten flappers on each unit, each consisting of a 3¼-in. hot-rolled steel bar with ¼-in. plate welded to its entire length. Bearings at the end of the bars are impregnated timbers with journal holes ¼-in. larger than the shafts. This construction seems to be the most rigid that could be devised. There will be some back leakage when they are closed but it should be insignificant as compared with the capacity of the pumps.

Each of the pumps is operated by a 5,000 hp. synchronous motor at 112.5 revolutions. The motors are wound for 6,600 v. and are started directly across the line by means of low voltage taps on transformers: taps being 65 and 75 per cent full voltage. It is expected that the 75 per cent tap will be used. The motors have sufficient damper winding to pull in synchronism at full load.

Power is to be supplied from a 23,000-v. substation in the Westinghouse plant which in turn is supplied by the Westinghouse power plant and also through feeders from the Duquesne Light Co. Duplicate 23,000-volt circuits are carried to the pumping station, cables being used to the south end of the Westinghouse plant yard.

The station, of course, can not be proven out under flood conditions without a flood. We, however, have closed the gates and built up a water head above the gates to El. 731 and operated two of the pumps at a time. Under these conditions the lift of the water is much higher than it will be under flood conditions when the water on the intake side of the pumps will be around El. 736. While the pumps were not discharging the full amount of water the propellers were doing full work at the high head. The test was entirely satisfactory in all particulars. The seal at the bottom of the gate was very good but it can be improved when there is high water on the low side of the gates and sand bags can be dropped down the face of the gates.

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Parking Meter Operation In Mexico City

SINCE the installation of parking meters was begun in Mexico City last fall, 520 meters have been placed in the more congested areas of the city. Official reports state that use of the meters has greatly relieved the parking problem, and has increased the treasury revenue.

Road, Vehicle and Traffic

Some of the methods by which the current road-planning surveys are being applied to working out a more efficient and safer highway transportation system

Last week's article, "Metering Our Roads," outlined the work of road mapping and traffic measurement that is now going on throughout the United States as part of a systematic investigation of the highway problem. Deeper study of the problem involves analyses of traffic and finances, research into accident causes, as well as traffic and vehicle behavior, and the like. From the resulting data, as recounted in the following, plans for highway improvement are to be developed.

— EDITOR

A HUNDRED FATAL ACCIDENTS per day testify to the fact that we have a highway problem. So also do the annual production and sale of several million motor vehicles and the existence of holiday congestion and discomfort on the roads. There is widespread doubt whether our road system is as good as modern skill can provide or as proper service to the public requires.

At the direction of Congress, therefore, the road system is being investigated by the state highway departments in cooperation with the U. S. Bureau of Public Roads. The basic elements of the investigation were described in these pages a week ago ("Metering Our Roads," *ENR* June 2, 1938, pp. 773-776). Maps of all roads from main trunks to farm lanes are being prepared, with record of curvature, grades, sight distances and surface. Counts of traffic are being made everywhere, and representative information is being obtained on origin and destination of vehicles. It is the first comprehensive study of road traffic ever made; its purpose is to supply the basis for determining how efficient is the existing road system and where and how it should be improved to best advantage.

But these data constitute only part of the necessary information. The traffic counts must be summarized and their meaning puzzled out. Financial facts must be compiled to show who pays for the roads—whether user, abutter or general taxpayer. Systematic effort must be made to discover where, why and how accidents happen, and to what extent the road, the vehicle and the driver contribute to them. Bottlenecks must be discovered and correctives planned out.

When all such facts have been brought together it should be possible to proceed with intelligent planning of an efficient traffic machine.

Where the traffic goes

Traffic counts, to be of effective use, are plotted on various forms of maps for study of their relation to the roads. In one form they are plotted on a full state map, as in Fig. 1, which shows part of the Ohio traffic map. The width of the band drawn over each road is a graphical measure of the mean density of traffic it carries.

To bring all roads into the traffic picture, traffic volumes are plotted on county maps, as in Fig. 2, a small section of the road system near Kingman, Kan. These maps are particularly important in throwing light on the amount of use made of local and land service roads.

Calculation of vehicle number and vehicle mileage from the traffic data leads in turn to various analyses, of which one is shown in Fig. 3, the relation between vehicle mileage and road mileage in Adams County, Pa. The curve shows at a glance that by far the largest volume of traffic is carried on a small mileage of the road; 90 per cent of the total movement of traffic is carried by roads of a traffic density above 25 vehicles in 8 hr., although these roads con-

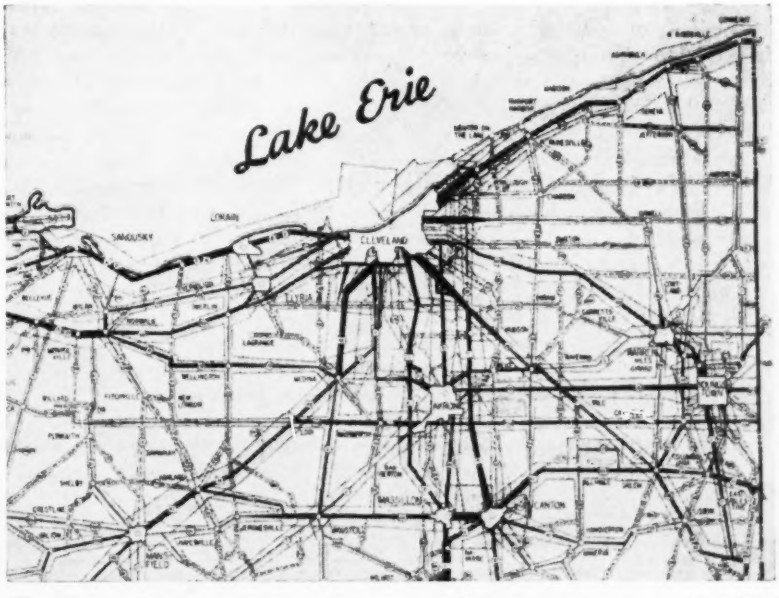

Fig. 1. Part of the traffic map of the state of Ohio. A complete map of this kind is prepared for each state, the band width indicating relative volume of traffic on different main roads. Secondary road network not shown.

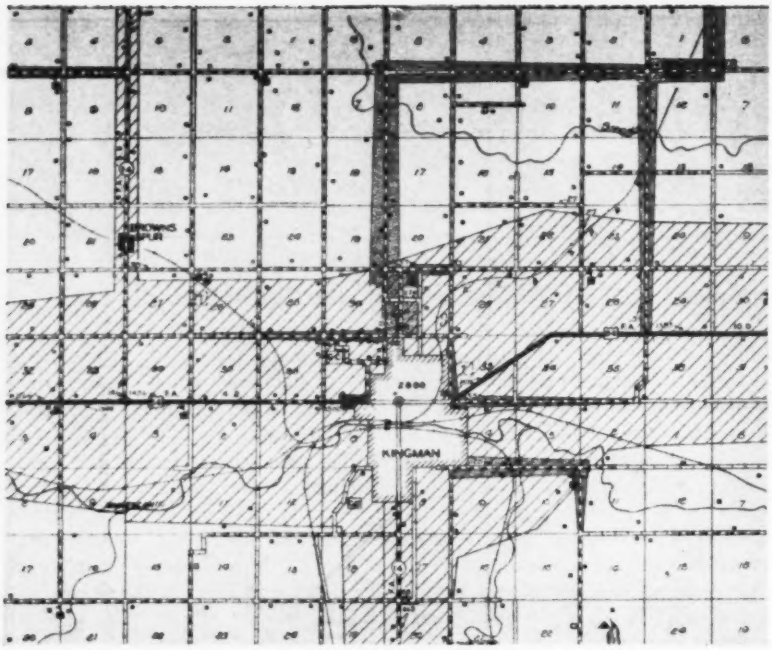

Fig. 2. Traffic densities on all roads are shown on county traffic maps, of which part of one is shown above. Here width and density of shading is used to indicate traffic density, the lightest shading representing less than 25 vehicles passing per day, the darkest shading 12,800 or more per day.

stitute less than 30 per cent of the total road mileage in the county—825 out of 1,171 mi. carry less than 25 vehicles in 8 hours! Such diagrams will be made for all counties in the United States.

Dimensions and weights of vehicles form an essential part of the data being collected. They are required both for estimates of freight carried (ton-miles of different kinds of freight) and for determination of prevailing weights and sizes in relation to the road surfaces upon which the vehicles are operated.

Two types of weighing stations are in use. The first, shown in Fig. 4, uses a loadometer, a small platform scale operating on the hydraulic principle which may be placed under one wheel of a truck by running the truck forward on it so that the wheel load is indicated by a pressure gage. Major measuring operations are made at pit-scale stations, Fig. 5, where the entire vehicle is weighed and at the same time measured for overall height, length and width. Data on tires, tare weight, etc., are also obtained at these latter stations.

Grade-crossing inventories

Complete records of grade crossings and their critical features form a separate part of the survey. At country grade crossings the distances along the track that can be seen from road points within 300 ft. of the crossing on each side are noted, and record is made of type of protection, frequency of rail and highway traffic, etc., as a basis for classifying urgency of improvement. A small section of a typical record for a railroad line in rural area is given in the accompanying table; such tabular forms are expected to provide a direct basis for crossing-improvement programs.

City grade-crossing conditions are recorded on maps, generally showing in detail all property within two blocks of the railroad line and covering an entire group of related crossings, since such crossings often must be considered for elimination in groups. These maps also constitute a part of the data used for determining urgency and priority of improvement.

Road life and finance

Where does the road money come from and how is it spent? Who uses the roads? Who pays for them? Such questions are closely related to sound road planning. The life of roads is important in the same connection. Extensive compilations of data on these points are in preparation.

The complete construction record of each major road is being obtained from the state highway department, including the date, character and cost of building, repair, resurfacing or widening, and reasons therefor.

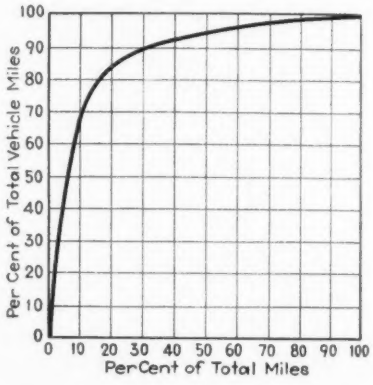

Fig. 3. Relations between traffic density, mileage, and vehicle mileage of all roads are worked out by curves summarized from traffic counts, and these curves are then used as the basis for a single diagram, such as the above (for Adams County, Pa.), which gives the general relation of percentage of road miles to percentage of vehicle miles. Diagrams of this kind generally show that a very small part of the total road network carries by far the largest part of the traffic.

A SAMPLE OF GRADE CROSSING DATA COLLECTED BY THE VIRGINIA HIGHWAY PLANNING SURVEY

(1)	(2)	(3)	(4)	(5)	(6)		(7)		(8)	(9)	(10)	(11)	(12)
Highway route number	Planning survey crossing number	County	24-hour highway traffic	Railway main or branch line	Number tracks		Number trains per 24 hours		Type of protection	Number accidents last 5 years	Minimum sight distance along railroad at points on highway 300 feet from railroad track	Priority group for elimination or betterment based on highway traffic, type protection, sight distance train movement, etc.	Remarks
					Main	Other	Fast	Other					
54	9	Hanover	1515	Main	2	1	0	61	Lights flashing	8	15	First	Needs increased protection
207	14	Caroline	492	Main	2	3	55	0	Signs only	2	74	Second	Needs increased protection
208	18	Caroline	86	Main	2	2	54	0	Signs only	1	45	Third	
17 & 2	28	Spotsylvania	1611	Spur		1			Signs only		30	Third	Spur only

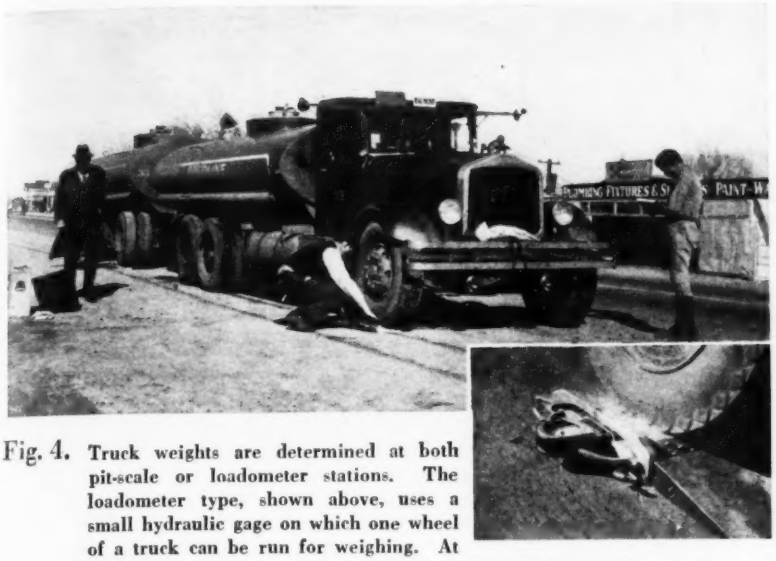

Fig. 4. Truck weights are determined at both pit-scale or loadometer stations. The loadometer type, shown above, uses a small hydraulic gage on which one wheel of a truck can be run for weighing. At loadometer stations, origin and destination data, information on the commodities carried and other data are recorded in addition to weight. The vehicle tare is deducted from gross weight to get the net weight carried.

The source of the road funds expended will also be noted, which data in connection with those of traffic volume, origin and destination will show, for different roads, to what extent the cost is defrayed by road users and to what extent it comes from other sources. Thus, who now pays for land-service roads, for through routes, for secondary roads, etc., is expected to appear from the financial and traffic studies.

The life data of roads are expected also to lead to important conclusions as to the economies of different road types as related to traffic, method of construction, soil and topography.

Coordinated are studies of land use and right-of-way policies. These studies in the main are still under development, but are expected to form a highly important part of the work.

Study of the use of lands adjoining roads, methods of protecting against roadside encroachment, etc., in conjunction with the safety studies as related to roadside use, will not only establish the facts as to present land-use policies and right-of-way condition but in all probability will lay the foundation for comprehensive new policies with respect to right-of-way and roadside control.

A real knowledge of accidents

Adequate safety study, it is realized, will require the development of uniform accident records and more adequate reporting than is now practiced. No attempt will be made to draw conclusions from past accident records, as their insufficiency is recognized. Some states have already enacted legislation to establish full accident reporting and investigation, and the Bureau of Public Roads plans to ask such legislation of all states.

Once suitable report data are available, it is expected to be possible to establish normal figures for accident rates and to classify them according to the nature and location of the road—on straightaway, on grade, on curve and hills, etc., and by comparison with the normal to determine local departures from normal and investigate their causes. Through this procedure it is hoped ultimately to identify those features of road design that are conducive to the occurrence of accidents, as well as those characteristics that contribute to low accident rates. Information thus developed will be valuable in making needed corrections of dangerous road conditions and will serve as the basis for development of standards of safe design.

Like the other studies, accident records are intended to be cumulative facts as a basis for drawing conclusions on the extent to which the highway design and construction are responsible for or contribute to accidents. The first objective of this study will be to determine the rates of accident occurrence in terms of vehicle miles at intersections, railroad grade crossings, curves, tangents, etc., taking into consideration such elements as shoulder design, surface types, conditions and widths and sight distances.

Vehicle operation and performance will be studied in a series of investigations which will involve five general phases: Highway capacity studies will develop the actual facility of movement, both of the average and of the individual vehicle, under

Fig. 5. At pit-scale stations all trucks are weighed and measured. In addition to height of vehicle and load, the overall length and width of the vehicle are measured; size and character of tires and information as to commodities, etc., are also noted.

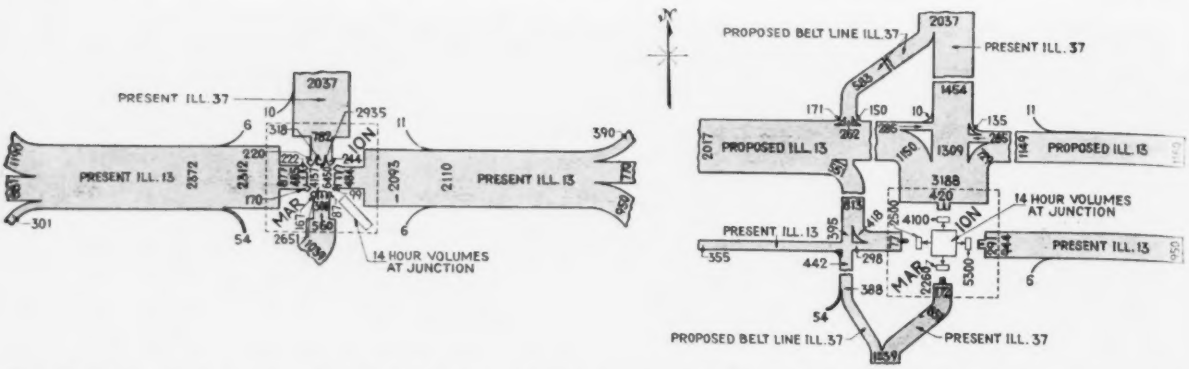

Fig. 6. One type of special study included in the road planning survey is the analysis of the effect on traffic of possible road changes, as in this instance of the proposed belt road around Marion, Ill. The sketch indicates the effect of the change on density of traffic over existing routes through the city.

a variety of conditions of alignment, width and traffic volume. These studies will produce such fundamental data regarding speeds and spacings of vehicles as may be necessary for use in theoretical consideration of highway design.

Grade-ability studies will be a continuation of the field work carried on by the bureau during the summer of 1937 with the cooperation of the Maryland highway planning survey. It is anticipated that detailed studies of a number of trucks of which the specifications are definitely known will make it possible to determine the maximum performance under various loadings. Passing-distance studies will include a detailed study of the individual vehicles in passing maneuvers on roads of various grades and alignments. The samples taken will include the full range of speeds available to present-day cars, and, since passing is a function of sight distance, the studies will be made on tangents, both level and on grades, and on curves.

Vehicle behavior studies are designed to show how the highway itself affects the movement of vehicles. But together with these there will also be driver studies, which will include determination of the period termed "perception or judgment time" and such other data as may be required to demonstrate the minimum distance which may be called a safe sight distance.

Many special studies are being included in the survey. An example is the study of bypasses or belt lines, based on measured traffic volume and destination and on the conclusions that may be drawn from the other traffic studies concerning the probable redistribution effected by a bypass. Fig. 6 is a specimen of such a study, relating to proposed belt lines around the city of Marion, Ill.

Auxiliary traffic studies of various kinds are in process or in preparation. One of these is the investigation of traffic bunching at or near critical points, such as on hills, or approaching intersections, to determine the deterrent and delaying effects of such conditions on traffic and therefore their reaction on the capacity of the entire road.

Road plans and programs

It must be remembered that the road planning surveys are intended solely to solve a practical purpose: Definite planning of the road system, better programming of road improvement, developing an equitable system of road finance and bringing about greater road safety. The methods by which this actual planning is to be done have not yet been worked out in detail, and will probably depend in large part on the actual results of detail analyses of the data.

The possible need for future through routes of superhighway type, for separation of truck and passenger traffic, for allocation of road widths, types, etc., are questions that as yet have not been translated into specific terms. They are under study by both the state departments and the federal officials, however, and definite procedures will be developed as quantitative data on roads and traffic accumulate. The major planning responsibility will rest on the state highway departments with respect to most of the questions involved; coordination of the state programs and study of special questions of interstate character as well as the formulation of policies that necessarily have countrywide application will probably be the work of the Bureau of Public Roads.

In conclusion, the vital fact to remember is that the survey outlined is not finished. Even the basic studies can not be concluded within a year or two. What has been begun is not to be thought of as a single venture into scientific study of the highway problem, nor can the results be expected to be compressed into a single report. Rather, it represents the launching of continuous planning within each state highway department to guide the administration of the roads.

Directing personnel

In the Bureau of Public Roads the work has been carried on mainly by personnel of the division of highway transport for the traffic and inventory phases, and by the division of control for the financial and road-life phases. In most of the states the work has been done by new organizations set up especially to handle it. To a certain extent this has been a bad feature because it has prevented the regular organization of the highway departments from becoming quickly familiar with the character of the studies and their results. That it was so organized was due mainly to the employment requirements of the emergency legislation. With those requirements relaxed and the work moving into a continuing phase, the planning organizations are being merged more intimately into the regular highway department organization with good effect.